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SWITZERLAND

FINANCIAL SECTOR ASSESSMENT PROGRAM

November 2025

TECHNICAL NOTE ON SYSTEMIC RISK ANALYSIS AND STRESS TESTING

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TECHNICAL NOTE

SYSTEMIC RISK ANALYSIS AND STRESS TESTING

Prepared By
Monetary and Capital Markets Department, IMF

This Technical Note was prepared by Marco Gross and the systemic risk analysis team he led, in the context of the Financial Sector Assessment Program (FSAP) in Switzerland, led by Oana Croitoru and overseen by the IMF's Monetary and Capital Markets Department. The note contains the technical analysis and detailed information underpinning the FSAP findings and recommendations. Further information on the FSAP program can be found at http://www.imf.org/external/np/fsap/fssa.aspx.

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AFS	Available-for-Sale
AUM	Assets Under Management
BMA	Bayesian Model Averaging
BU	Bottom-Up
CCoB	Capital Conservation Buffer
CCyB	Counter-Cyclical Capital Buffer
CET1	Common Equity Tier 1
CHF	Swiss Franc
COF	Cost of funding
CRE	Commercial Real Estate
CSP	Cloud Service Provider
DB	Defined Benefits
DC	Defined Contributions
D-SIB	Domestic Systemically Important Bank
DSTI	Debt Service-to-Income ratio
DTI	Debt-to-Income ratio
EBIT	Earnings Before Interest and Taxes
EEA	European Economic Area
EU	European Union
EUR	Euro
FINMA	Swiss Financial Market Supervisory Authority
FOEN	Federal Office of the Environment
FSAP	Financial Sector Assessment Program
FSIO	Federal Social Insurance Office
FSO	Federal Statistics Office
FX	Foreign Currency or Foreign Exchange
GBP	British Pound
GDP	Gross Domestic Product
GHG	Greenhouse Gas
G-SIB	Global Systemically Important Bank
GUSTAVO	Geneve, Uri, Schwyz, Ticino, Appenzell Innerrhoden, Valais, and Obwalden
GWL	Global Warming Levels
HBS	Household Budget Survey
HFT	Held-for-Trading
HQLA	High Quality Liquid Assets
HTM	Held-to-Maturity
IAIG	Internationally Active Insurance Group
ICR	Interest Coverage Ratio
IPCC	Intergovernmental Panel on Climate Change
IRB	Internal-Ratings Based Approach

JPY	Japanese Yen
KGV	Cantonal Building Insurer
LCR	Liquidity Coverage Ratio
LGD	Loss Given Default
LOB	Law on Occupational Benefits
LTI	Loan-to-Income
LTV	Loan-to-Value
MtM	Mark-to-Market
NA	Not available
NBFIs	Nonbank Financial Institutions
NCCS	National Center for Climate Services
NFCs	Nonfinancial Corporates
NFCI	Net Fee and Commission Income
NGFS	Network for Greening the Financial System
NII	Net Interest Income
NPL	Nonperforming Loan
NSFR	Net Stable Funding Ratio
OASI	Old Age and Survivors Insurance
OCI	Other Comprehensive Income
OECD	Organisation For Economic Cooperation and Development
OPSC	Occupational Pension Supervisory Commission
PAYG	Pay-as-you-go
PCR	Provision Coverage Ratio
PD	Probability of Default
PiT	Point-in-Time
RAM	Risk Assessment Matrix
RCP	Representative Concentration Pathway
REITs	Real Estate Investment Trusts
ROA	Return on Assets
RRE	Residential Real Estate
RWA	Risk Weighted Asset
SILC	Statistics on Income and Living Conditions
SMEs	Small and Medium-Sized Enterprises
SNB	Swiss National Bank
SST	Swiss Solvency Test
STA	Standardized Approach
TD	Top-Down
TTC	Through the cycle
VaR	Value-at-Risk
WEO	World Economic Outlook
WRI	World Resources Institute
USD	US Dollar

EXECUTIVE SUMMARY[1]

The Swiss financial system has navigated turbulent times since the 2019 FSAP. The COVID 19 pandemic, geopolitical conflicts, and the collapse of Credit Suisse (CS) in 2023—previously the second largest G-SIB relative to domestic GDP in the world—have tested the resilience of the Swiss financial center and the economy. Financial stability has been maintained, even though the government-assisted merger between UBS and CS, entailing significant contingent fiscal liabilities, has undermined the credibility of the Too-Big-To-Fail (TBTF) regime and revealed gaps in supervision, resolution, and crisis management in Switzerland.

Switzerland's financial sector operates in a generally favorable macro-financial environment but faces structural vulnerabilities. These pertain to rising concentration in the financial system and associated risks of competitive distortion, periods of strong Swiss Franc appreciation, which burdens Swiss exporters and complicates the conduct of monetary policy, high household debt and the associated banks' large mortgage credit exposure, as well as high and rising house prices and related housing affordability strains. The banking system's profitability has been weak, due to a combination of high operating costs and low interest rates that put a drag on interest income.

Various structural factors support mortgage debt growth and its high level in Switzerland. These stem from tax incentives, the interplay with pension saving schemes, and lenient amortization requirements. This warrants policy choices that do not fuel further but rather counter household debt creation and stretching house price valuations, for instance, through borrower-based macroprudential policies.[2] Real estate (RE) firms and the associated commercial real estate activity should be monitored vigorously, given the prevalent market-based finance structures of RE firms; and more data be collected in this context.

The bank solvency stress test suggests that the Swiss banking system can withstand severe economic downturn scenarios. The banks' solvency ratios fall notably but remain above minimum requirements at the system level, under severe demand and supply shock scenarios. The capital depletion for asset and wealth management banks is more pronounced than for other banks, but important caveats surround these results, including the high uncertainty regarding certain risk parameters for such banks. The FSAP recommends enhancing the data coverage for this bank cluster and incorporate it in the Swiss authorities' stress tests and risk analyses.

Liquidity risk profiles for banks were much in motion since the Covid pandemic; and the forward-looking liquidity stress test reveals a few weak banks. Liquidity conditions were in flux in recent years due, inter alia, to the "dash for cash" dynamic during the pandemic, directional turns in monetary policy since 2022, and the UBS-CS merger in 2023 which caused notable deposit

[1] This note was prepared by the systemic risk analysis (SRA) team led by Marco Gross, including Salvatore Dell'Erba, Jamie Fraser, Javier Urunuela Lopez, Bernhard Mayr, and Betty Adane Afework.

[2] See the related recommendations in the companion FSAP Technical Note on Macroprudential Policy and Real Estate Risks.

outflows and flows among banks. The liquidity stress test simulations identified a few banks—mostly from the regional and the asset and wealth management cluster—that would face liquidity strains under hypothetical, severe liquidity withdrawal scenarios. The associated liquidity shortfall is not negligible but sufficiently contained from a system perspective. A related important recommendation for the Swiss authorities is to develop a liquidity stress test model, to support its analytical capability.

Climate physical risks can affect the banking system, but the insurance transfer mechanism limits the impact. Banks' exposure to climate-related hazards varies by indicator and bank type; while cantonal and regional banks are most exposed, according to various indicators. An extreme flood scenario could impact property values and bank capital ratios, with a significantly higher effect than from increasing premiums due to increases in average annual flood damages. While climate physical risk can affect the banking system, insurance transfer mechanisms limit the effects. More data related to mortgage exposures and collaboration across institutions would allow the authorities to continue incorporating and better monitoring climate-related risks.

The insurance sector has shown resilience under the stress test scenarios. The solvency stress test for six Swiss insurance groups suggests that they are able to withstand severe shock scenarios, even though solvency ratios fall significantly. The impacts stem from higher credit spreads, shocks on property holdings as well as equity exposure. A separate cyber stress test showed that cyber aspects are increasingly relevant for underwriting, but related risks remain contained from a solvency perspective.

The Swiss insurance sector has several safeguards against liquidity risk, but supervisors need to remain vigilant. Access to the repo market, in which the Swiss National Bank (SNB) is also active, and contractual and legal restrictions to policy surrenders reduce the potential impact from two notable sources of liquidity strain: margin calls on derivatives and mass lapses. Insurers hold a large notional amount of derivatives to hedge against appreciation of the Swiss Franc and to a lesser degree against a fall in interest rates. The scenario used for the solvency stress test would have led to a net positive liquidity impact from derivatives holdings. Supervisors should run regular liquidity stress tests to assess the impact of different scenarios.

The pension fund sector appears robust, but some uncertainties remain due to data limitations. Despite a difficult market environment and increasing life expectancy, pensions funds have fared well over the last years. Pension fund bankruptcies are rare and have mostly involved small institutions. As a result, gross insolvency payments by the guarantee fund, which have to be financed by the pension sector as a whole, have been low and stable. However, pension funds have some leeway in calculating their funding position, which smaller firms use to overstate it by using higher (technical) interest rates to discount their liabilities, thus assuming higher future expected returns and keeping their fluctuation reserve lower than justified by their asset exposure. The FSAP recommends closing identified data gaps.

Table 1. Switzerland: Main Recommendations

#	Recommendation	Timing[1]	Authorities
Data Availability and Monitoring			
1	Keep monitoring housing and mortgage market developments, including house price valuation, affordability strains and interest rate risk for households, and consider related macroprudential policies to contain systemic risk.[2]	ST/C	FINMA, SNB
2	Monitor and collect more data pertaining to commercial real estate business, real estate (RE) firms' borrowing from banks and capital markets, to assess their relevance and contribution to systemic risk and vulnerabilities vigorously and continuously. Also consider developing transaction-based price indices for commercial RE.	ST/C	FINMA, SNB
3	Compile bilateral exposure data involving all financial institution types, beyond banks, for authorities' network and contagion analysis to achieve a fuller system coverage.	MT	FINMA, SNB
4	Collect more data on a regular basis to enhance the risk analysis and modeling, including related to mortgages for banks other than SIBs, banks' trading and investment portfolios, banks' foreign exposures in general, and Lombard loan exposures specifically.	MT	FINMA, SNB
5	For insurers, reduce dependence on ad-hoc data requests and establish more frequent regulatory reporting.	MT	FINMA
6	Develop a dataset and regularly collect data for pension funds to enable market-wide horizontal and systemic risk analyses, particularly regarding asset exposures.	MT	OPSC
7	Collect more data from financial institutions to quantify climate-related risks. The authorities should collaborate with the Federal Office of Environment, building insurers, other relevant authorities, and private sector entities to monitor such risks.	MT	SNB, FINMA
Methodologies and Analytical Tools for Systemic Risk Analysis			
8	Develop a bank liquidity stress test model, to complement the monitoring based on data and the analysis of regulatory metrics as so far prioritized.	MT	SNB, FINMA
9	Keep developing micro data-based models for nonfinancial corporates and households and connect them to the bank solvency stress test model.	MT	SNB
10	Develop additional model structures pertaining to asset and wealth management banks, to include them in the stress test models and thereby support the analysis of their vulnerabilities and systemic relevance.	MT	SNB, FINMA
11	Benchmark and assess the banks' provisioning practices for performing exposures.	MT	FINMA, SNB
12	Conduct liquidity-focused top-down stress tests and scenario analysis for insurers.	MT	FINMA
13	Ensure comparability of the calculation of pension funds' funding position. Provide cantonal supervisors with the necessary authority and instruments to intervene.	MT	OPSC, cantonal supervisors, Federal Council
14	Consider providing more information about the macro-financial scenarios and bank solvency stress test results in SNB's financial stability report.	MT	SNB
Cross-Institutional Collaboration for Monitoring Systemic Risks			
15	FINMA and the SNB should collaborate regarding the reciprocal benchmarking of top-down and bottom-up stress test results for banks.	MT	FINMA, SNB
16	Establish a common platform to assess and discuss market/sectoral developments and potential risks to financial stability, the findings of which should feed into the Steering Committee/Standing Committee for financial stability discussions.	MT	OPSC, Federal Council, cantonal supervisors, FINMA, SNB

I Immediate (within 1 year); ST Short Term (within 1-2 years); MT Medium Term (within 3−5 years). C Continuous.

[2] See the companion FSAP Technical Note on Macroprudential Policy for additional bespoke recommendations.

INTRODUCTION

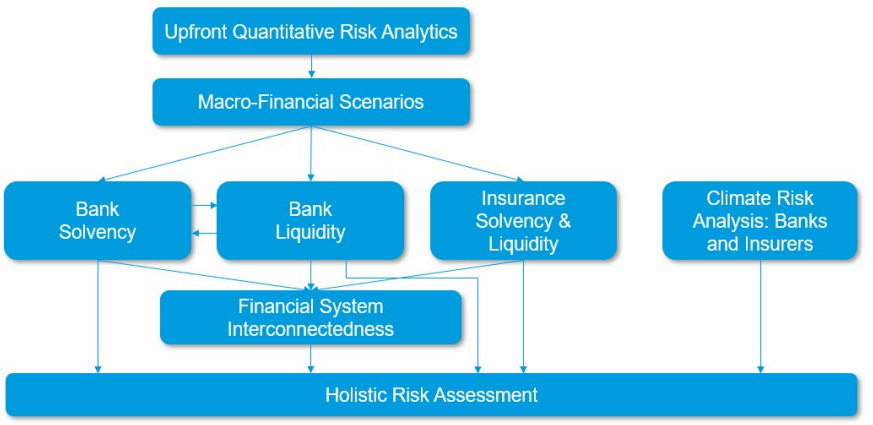
1. This note presents the findings and recommendations of the systemic risk analysis (SRA) conducted for the Swiss financial system as part of the Switzerland 2025 FSAP. The analysis intends to help identify the sources of vulnerabilities and systemic risk facing the Swiss financial sector, to inform policy advice and strengthen the resilience of the system to absorb external adverse shocks and to detect and counter endogenously building vulnerabilities of the financial system.

2. The analysis involves various stress test exercises to assess the resilience of the financial system (Figure 1). They cover banks and insurance firms. Risks were evaluated at the level of individual firms, and from a system perspective, using models for solvency and liquidity for banks and insurers, and considering solvency-liquidity feedback for banks. The risk analysis for nonfinancial corporates and households provided input into the banks' solvency analysis. Vulnerabilities and risks were also analyzed in the real estate sector to inform the stress test scenario design. A climate risk analysis assessed how insurers and banking system solvency would be affected under adverse physical risk materialization scenarios.

3. A holistic vulnerability analysis combines all findings from current conditions and all forward-looking model-based analyses. The bank-level quantitative outputs are combined to compute vulnerability rankings for all firms. This is meant to assess whether there are financial entities that would be vulnerable and impactful at the same time and thereby represent a source of concern.

4. The stress tests placed emphasis on structural—instead of econometric—models, given Switzerland's specific historical macro-financial dynamics. A long period of low and negative policy interest rates, and the associated specific macro-financial dynamics (including, for example, very low default rates for mortgages) imply a challenge for econometric modeling methods. Structural model methodologies for various risk parameters, rooted in micro data, were therefore prioritized.

Figure 1. Switzerland: Systemic Risk Analysis (SRA)



Sources: IMF staff.

FINANCIAL SYSTEM STRUCTURE AND ECONOMIC ENVIRONMENT

A. Financial System Structure

5. Switzerland's financial system is large. The financial system at end-2023 represented about 1,000 percent relative to Swiss nominal GDP (Figure 2[A-B]). This is split into about 600 vs. 400 percent for NBFIs and the banking system, respectively. The four largest banks—designated systemically important banks, including one GSIB and three DSIBs—represent 264 percent of GDP and 65 percent of banking system assets.

6. The banking system keeps consolidating and experienced a material additional concentration hike following the UBS-CS merger in 2023. The number of banks dropped from 275 in 2014 to 213 in 2024 (22 percent decline, Figure 2C.). This trend is explained primarily by foreign banks ceasing their business in Switzerland and various asset and wealth managers consolidating their activity, amid competitive pressure and subdued historical profitability. Banking system assets shrank from 500 percent relative to GDP in 2021 to 400 percent in 2024, mainly due to a combination of falling excess reserves and shrinking client loan portfolios (other than mortgage lending). The CS takeover by UBS in March 2023 notably increased the level of concentration beyond the already high concentration level before the merger (Figure 2[D-E]).

7. The banking system can be split into five clusters. These include large banks (i.e., SIBs, one GSIB and three DSIBs), cantonal banks, asset and wealth management banks (also referred to as stock exchange banks by the SNB), regional banks, and a residual of other banks that do not fit the other categories (Figure 2F.).[3] The large banks cluster contains one cantonal bank, the largest among the cantonal banks, which is also a D-SIB. Cantonal banks mostly engage in mortgage business, but some of them are also active in asset management. They are mostly active in their own cantons but some of them expand their business beyond, domestically and to an extent cross-border. Cantons hold more than one third of shareholder voting rights of cantonal banks. Various forms of cantonal guarantees are in place for all cantonal banks except one.[4]

8. The insurance sector is well developed and has a significant international footprint. Annual insurance premium flows amount to about 60 percent of Swiss GDP. The sector is highly concentrated, with the five largest life insurers and non-life insurers accounting for 80 percent and 67 percent of their respective markets. The reinsurance firm Swiss Re is the second largest reinsurer in the world and earns nearly all its premium income outside Switzerland.

9. The pension fund sector is large and fragmented, with assets of around 140 percent relative to GDP. At present, more than 1,300 institutions are operating occupational pension

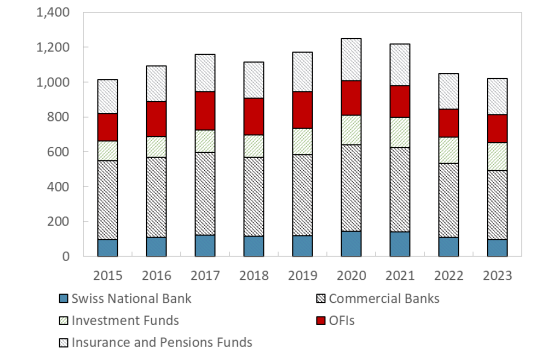
[3] The residual "other" bank cluster contains selected foreign-owned subsidiaries serving international clients and conducting niche retail services, and small banks with rather pure consumer credit focus.
[4] More information about the defining features of the bank categories can be found here: https://data.snb.ch/en/topics/banken/doc/explanations_banken#bgrbsk

schemes. Some consolidation trends can be observed. The top 14 percent of the largest entities represent 82 percent of active members and total pension assets. Defined-contribution (DC) regimes dominate the Swiss pension market, representing almost 90 percent of pension liabilities.

Figure 2. Switzerland: Financial System and Banking System Size and Concentration

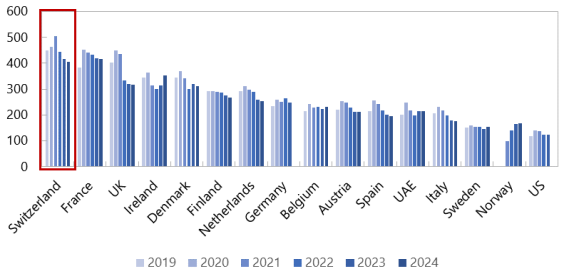
The financial system shrank since the pandemic; yet is still very sizeable relative to domestic GDP.

A. Financial System Structure
(total assets relative to nominal GDP, in percent)



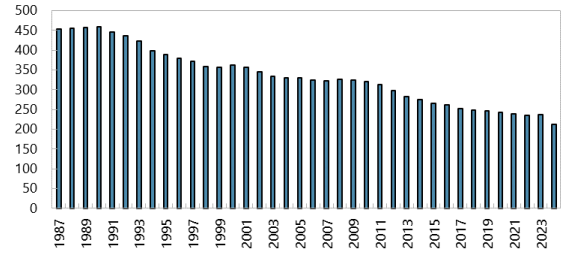
The banking system share in financial system assets amounts to a material 400 percent of GDP in 2024.

B. Banking System Size
(total assets relative to nominal GDP, in percent)



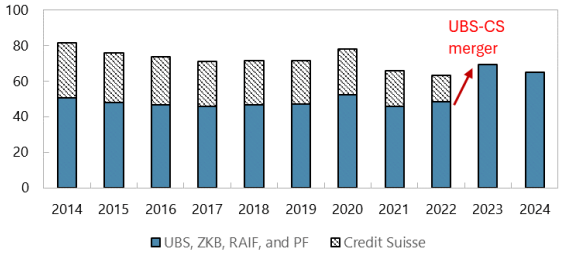
The number of banks follows a secular, multi-decade lasting consolidation trend.

C. Count of Banks
(count at end-year, parent level, 1987-2024)



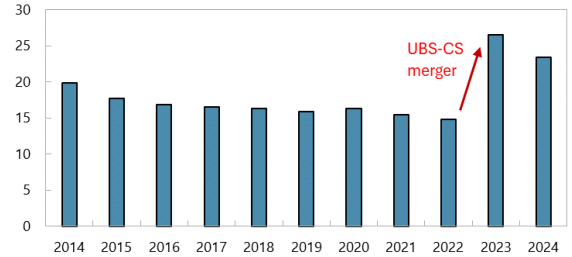
The share of the largest four banks (SIBs) excluding CS jumped notably with the UBS-CS merger…

D. Share of Largest Swiss Banks in the Banking System
(percent, selected banks' assets in banking system assets)



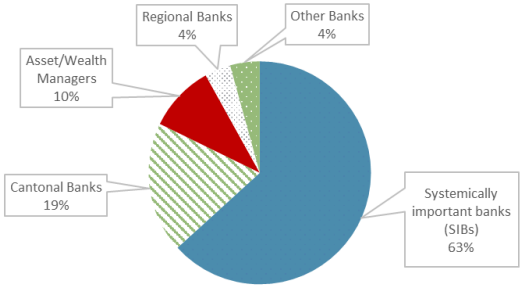
…which increased the already high (pre-CS-merger) concentration in the banking system much further.

E. Banking System Concentration
(Herfindahl index based on the largest 90 Swiss banks)



Beyond the SIBs, cantonal banks and asset managers represent another 30 percent of banking system assets.

F. Bank Clusters
(share in total banking system assets, at end-2024)



Sources: SNB, FINMA, banks' financial reports, and IMF staff calculations.
Notes: UBS = UBS Group AG, ZKB = Zuercher Kantonalbank, RAIF = Raiffeisen Group, PF = PostFinance, CS = Credit Suisse Group AG. The 90 Swiss banks involved in the Herfindahl index calculation represent more than 90 percent of banking system assets in all years.

10. The remainder of the NBFI sector comprises investment funds and OFIs, each representing about 160 percent in total assets relative to GDP. OFIs represent a heterogenous group, including securities and derivatives dealers, corporate leasing firms, captive finance companies, and others. Data on the size of other NBFIs comes from the financial accounts statistics, which only account for the Swiss portion of the sector. This makes it difficult to estimate the total balance sheet size of Swiss NBFIs. Since 2022, the authorities have collected data on exposures, leverage, liquidity, and counterparty risks of investment funds, including real estate investment funds, which provides some information on the risk profile and vulnerability of these institutions. Some categories of NBFIs are not subject to oversight or reporting to any supervisory institution, making it difficult to assess implications for financial stability.

11. Financial market infrastructures and exchanges are dominated by a single private entity. The SIX Group AG (owned by banks) provides all trade and post trade services. The group operates the SIX Stock Exchange (Europe's third largest); the real time gross settlement payment system (RTGS); the central counterparty (CCP); the Central Securities Depository (CSD); the securities and settlement system (SSS); the Swiss Digital Exchange (SDX); and the SIX Structured Products Exchange. The SIX Stock Exchange has a free float market capitalization of around CHF 1.8 trillion (225 percent of GDP, at end-2024) and lists and trades some of Europe's largest industry leaders.

12. Switzerland has progressed in preparing the infrastructure for digital asset trading and the fintech sector is expanding. The SDX went live in 2021, when the legal framework for distributed ledger technology (DLT) was introduced. By supporting tokenized securities, cryptocurrencies, and open finance, the SIX group aims at increasing the attractiveness of the Swiss financial center. Project Helvetia—exploring a wholesale central bank digital currency (wCBDC) for settling tokenized financial assets—has advanced to a pilot phase in a "live" environment. The number of fintech firms and their share in fintech funding have been rising. The government introduced in 2019 a new category in the banking law or fintech license, allowing institutions to accept public deposits up to CHF 100 million in crypto assets, if these are not invested, or no interest is paid on them. Take-up has been so far limited to payment services and further adjustments to this license are contemplated as part of an upcoming legislative initiative.

B. Macro-Financial Environment

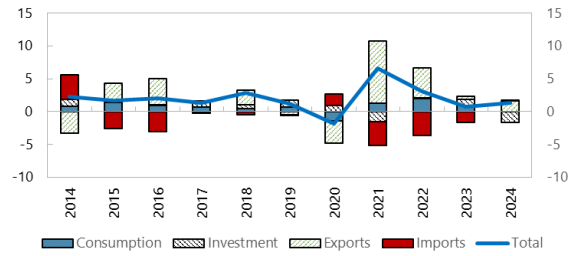
13. Switzerland's financial sector operates in a favorable economic environment. GDP growth has been steady and supported by Switzerland's exports (Figure 3A.). Inflation has been stable and low, while sliding into deflation occasionally over the past two decades. Unlike many other advanced economies, it experienced only modest inflation pressures following the pandemic and the Russia-Ukraine war (Figure 3[B-C]), due to a low share of energy in the consumer price index, limited reliance on fossil fuels for electricity generation, and a strong CHF.[5] Policy and market rates were low and negative for long, until rates began to rise since Jan-2022 (Figure 3[D-E]).

[5] The foreign, "imported" component of inflation amounts to about 24 percent according to SNB estimates, which is higher than in various euro area countries.

Figure 3. Switzerland: Macro-Financial Environment

Swiss real GDP growth turned less negative in the pandemic year 2020 than in many other countries.

A. Real GDP Growth and Contributions
(year-on-year in percent)

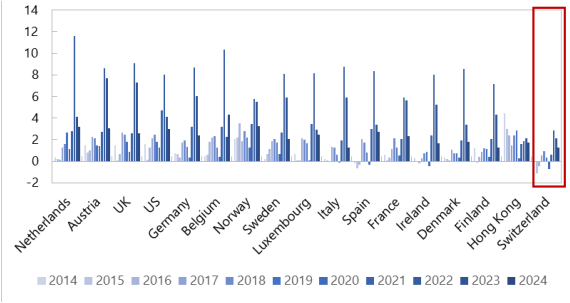


Switzerland experienced price deflation repeatedly over the past two decades.

B. Price Inflation
(year-on-year in percent)

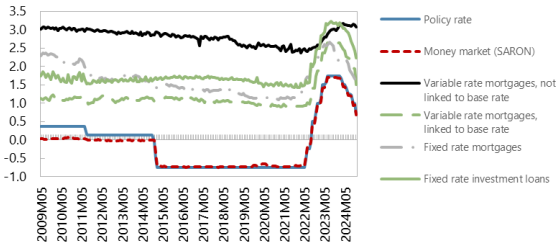
Inflation is low and stable, and during the pandemic it was spiking notably less than in other countries.

C. Price Inflation in Cross-Country Comparison
(year-on-year in percent)



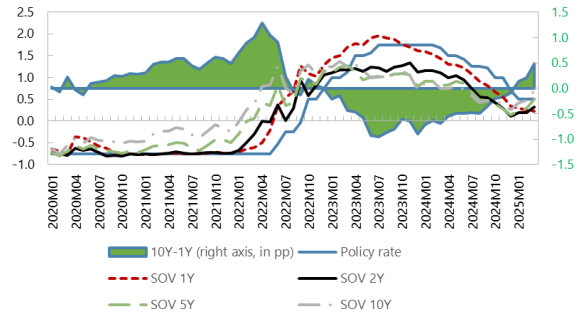
The rate hike cycle that began in June 2022 made rates on new lending follow suit.

D. Policy Rate, Money Market Rates, and Bank Lending Rates on New Business
(percent, within-month averages, May-2009 to Dec-2024)



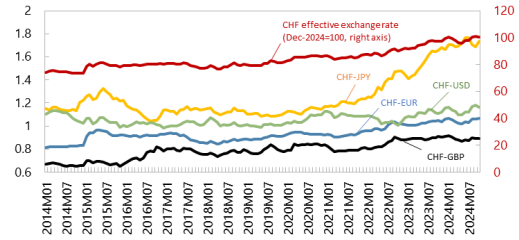
That rate hike cycle compressed and inverted the yield curve during the end-2022 to end-2024 period.

E. Swiss Sovereign Bonds and Yield Curve Slope
(within-month average yields in percent, slope in p.p.)



The CHF experiences a structural appreciation trend since long, burdening Swiss exporters to an extent.

F. Bilateral and Effective Swiss Franc Exchange Rates
(within-month average, 1 CHF in FX, up means CHF appr.)



Sources: SNB, FSO, and IMF staff calculations.

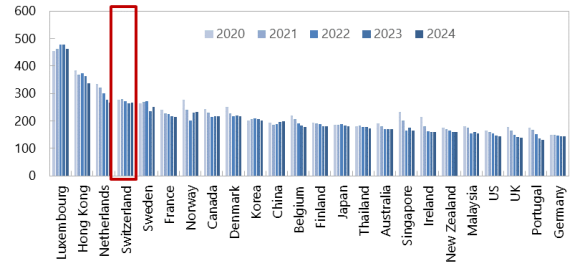
14. Switzerland's strengths relate to sound fiscal conditions, openness to financial innovation, and a safe haven perception. The positive economic factors include (1) strong fiscal fundamentals, with general government gross debt to GDP at 25 percent in 2024 (Figure 4[B-C], and total public debt at 32 percent of GDP); (2) openness to innovation, with recent examples being the

exploration of blockchain technology and wholesale CBDC; and (3) the country's safe haven status, implying capital inflow dynamics rather than outflow risks during times of global instability. However, the safe haven status induces CHF appreciation trends and structural downward pressure on inflation, in turn implying challenges for monetary policy.

Figure 4. Switzerland: Indebtedness

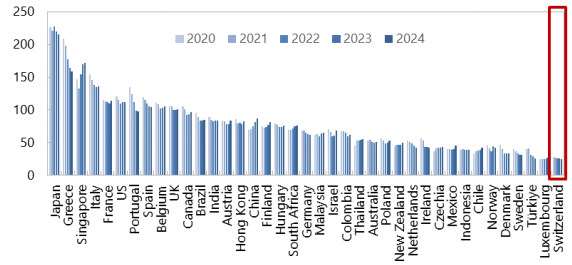
Swiss nonfinancial private sector debt is high, at 267 percent relative to nominal GDP in 2024.

A. Nonfinancial Private Sector Debt to GDP
(percent)



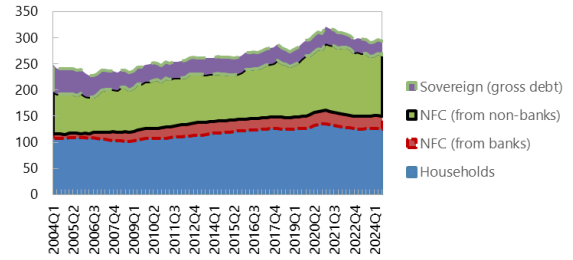
Swiss sovereign debt, on the other hand, is particularly low, at 25 percent relative to GDP in 2024.

B. Sovereign Debt to GDP
(gross debt to nominal GDP in percent)



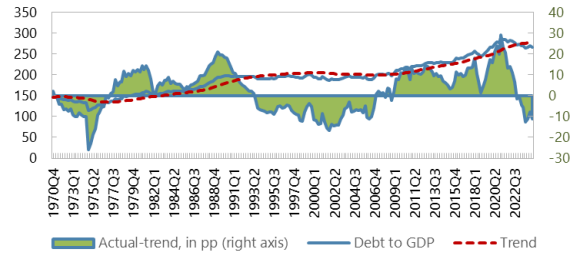
Swiss household and NFC debt levels are comparable.

C. Swiss Debt to GDP – By Sector
(percent, 2004Q1-2024Q3)



NFPS credit is upward trending since long, while trend and gap metrics point to a recent deceleration.

D. Swiss Nonfinancial Private Sector Credit to GDP and BIS Credit Gap
(percent and percentage points, 1970Q4-2024Q3)



Sources: SNB, BIS, FSI, and IMF staff calculations.
Notes: In panels A and B, the data points for 2024 pertain to 2024Q3.

15. Macro-financial vulnerabilities arise from a combination of fiscal, external, and private sector imbalances. Noteworthy structural weaknesses include: (1) mounting pressure on public finances due to the anticipated financing gap of the pension system, which may necessitate fiscal adjustments; (2) the country's sensitivity to foreign demand, compounded by a continued CHF appreciation trend (Figure 3F.) which weighs on export competitiveness; and (3) the elevated level of nonfinancial private sector debt, including particularly its household debt component (Figure 4).

16. The SNB's balance sheet and profits remain sensitive to global financial market conditions, particularly exchange rate fluctuations. FX moves influence SNB's profits and its equity due to its sizeable FX holdings that are not hedged. They expanded during 2009-21 as the SNB engaged in large FX purchases, combined with low and negative interest rates, to counter deflation risks. This contributed to CHF depreciation and valuation gains for the SNB. FX sales,

after 2021, then contributed to CHF appreciation and valuation losses. In parallel, higher bank reserve requirements were enacted, from 2.5 percent to 4 percent, since July 2024. This lowered the interest expense for the SNB, supporting its income and seigniorage distribution potential to the central government and cantons. In 2024, SNB profits were supported by FX and equity gains, a stronger USD, and valuation gains from gold.

17. A mutual recognition agreement between the UK and Switzerland was concluded in December 2023, which aims to deepen the financial services provision across these two jurisdictions. The two countries now jointly recognize their regulatory regimes, which support financial service business in both countries. Banks, asset and wealth managers, investment service providers, and insurers from both countries would be allowed to service clients in the respective other country.

C. Banking System Profitability, Solvency, and Liquidity at a Glance

18. Swiss banks' profitability is structurally weak and heterogeneous across bank clusters. The banking system's ROA was 0.4 percent in 2024 (Figure 5A.), just at the average of the past ten years.[6] This low profitability is explained by a combination of low interest rates over the past decade and structurally relatively high operating costs. A large share of income stems from fees and commissions for big banks, including asset and wealth managers. SIBs and regional banks are less profitable than asset and wealth management banks, at present (Figure 5B.).

19. Solvency ratios appear sufficient at the system level but are heterogenous across banks and bank clusters. Capital ratios at the banking system level rest at moderate levels in cross-country comparison (Figure 5C.). The gap between actual and required capital ratios is smaller for SIBs and cantonal banks (Figure 5D.). Asset and wealth management banks operate with higher buffers. NPL ratios are structurally low (Figure 5E.). This is reflective of low default rates, amid a historically stable economic environment with low volatility and low interest rates (which fuels leverage, however, and therefore vulnerabilities).

20. Liquidity risk profiles for banks were in flux since the pandemic, due to numerous factors. These included the "dash for cash" dynamic during the Covid pandemic, SNB's shift in monetary policy since 2022, and the UBS-CS merger in 2023. The latter led to sizeable deposit withdrawals and transfers to other banks. Due to the monetary policy shift since 2022, the share of banks' reserves in total assets fell from 30 to 25 percent around September 2022 and dropped further to 20 percent until end-2024 (Figure 6A. and Figure 7). The upward move of interest rates during this time induced bank customers to move from sight deposits to term deposits (Figure 8C.), which, from this perspective, reduces liquidity risk for banks. LCRs at system level rank well in cross-country comparison (Figure 6B.), while they are heterogeneous across bank clusters and are overall

[6] The one-off sizeable ROA for the Swiss banking system in 2023—at 0.9 percent—was driven by UBS's takeover of CS and the implied one-off valuation gain that resulted from the notable gap between CS's purchase price and its value of assets.

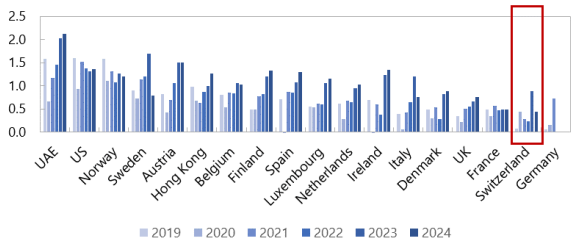
to an extent volatile (Figure 6[C-D]). NSFRs, like LCRs, suggest that asset and wealth management banks have stronger liquidity profiles than other banks (Figure 6[E-F]).

21. Liquidity requirements will likely be further reviewed and strengthened by the Swiss authorities going forward. Some steps were taken already, e.g., the issuance of an amended liquidity ordinance in July 2022. Higher liquidity requirements are foreseen for SIBs. A review of the effectiveness of the stricter liquidity requirements is expected to be delivered by the Swiss authorities by end-2026. Also under discussion is the more explicit allowance of the LCR metric to fall below 100 percent temporarily in periods of stressed conditions; aligning with Basel III guidance that permits such flexibility when justified by sound contingency plans.

Figure 5. Switzerland: Selected Bank Profitability, Solvency, and Asset Quality Metrics

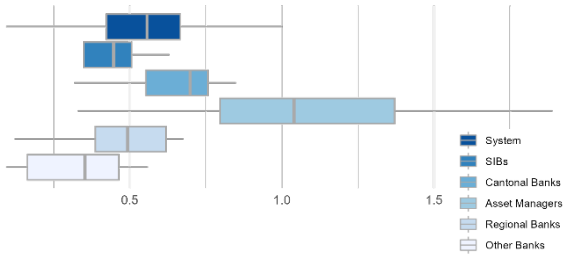
Swiss banks' profitability appears structurally weak.

A. Return on Assets (ROA)
(pre-tax net income over interest-bearing assets, in percent)



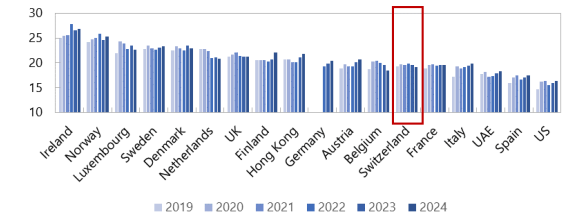
SIBs and regional banks are less profitable than asset/wealth management banks.

B. Return on Assets (ROA) by Bank Clusters End-2024
(pre-tax net income over interest-bearing assets, in percent)



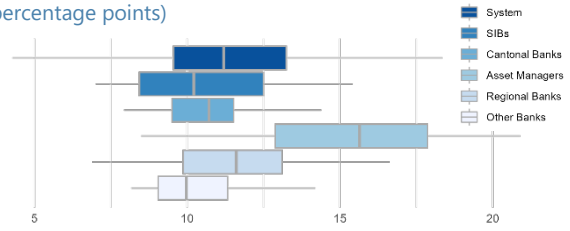
Weak profitability contributes to capital ratios resting at mediocre levels in cross-country comparison.

C. Regulatory Capital Ratio
(regulatory total capital over RWA, in percent)



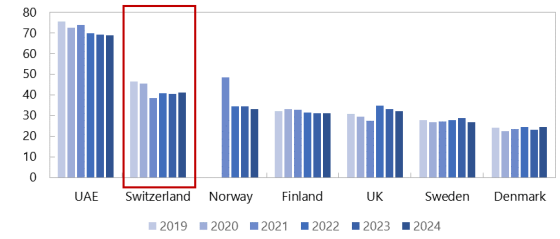
The gap between actual capital ratios and capital requirements is smaller for SIBs and cantonal banks.

D. Excess Capital Ratios by Bank Clusters, End-2024
(percentage points)



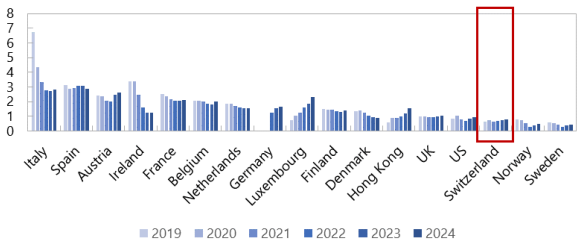
Risk weight densities range between 40-50 percent.

E. Risk Weight Densities
(risk weighted assets over total assets, in percent)



NPL ratios are structurally low, being reflective of low historical defaults for bank loan portfolios.

F. NPL Ratios
(nonperforming loans in gross loans, in percent)

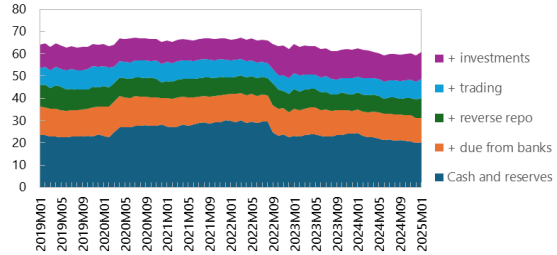


Sources: FINMA, banks' financial reports, and IMF staff calculations.

Figure 6. Switzerland: Bank Liquidity Metrics

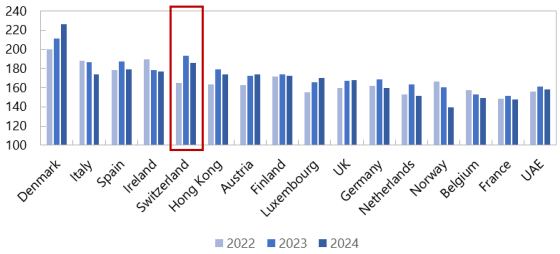
Reserves appear sizeable, though they fell in autumn 2022 after the SNB started its tightening cycle to counter inflation.

A. Selected Asset Types over Customer Deposits and Liabilities to Banks
(percent)



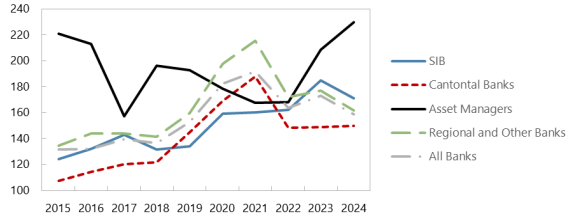
The Swiss banking system's LCR ranks favorably in cross-country comparison at the aggregate level.

B. Liquidity Coverage Ratio (LCR)
(percent)



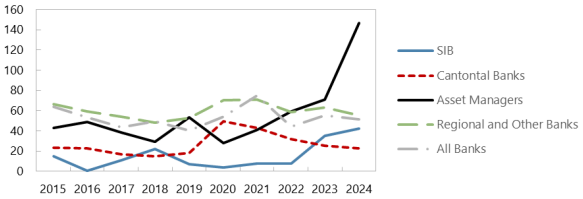
The LCR is systematically lower for cantonal banks, and higher (though volatile) for asset/wealth managers.

C. Swiss Banks' Liquidity Coverage Ratio (LCR)
(median across banks in each cluster, in percent)



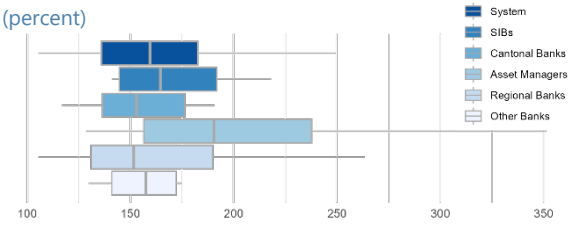
The LCR's cross-bank heterogeneity has risen over the past years for the asset/wealth management banks.

D. Swiss Banks' LCR – Interquartile Range
(interquartile range across banks per cluster, in p.p.)



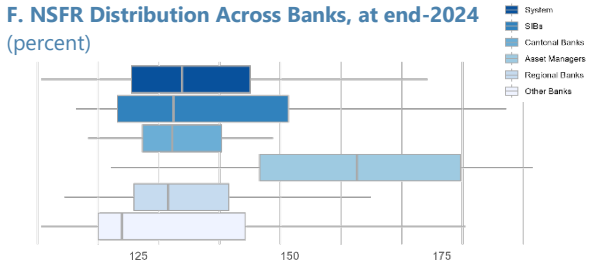
The LCR distributions are wider for asset/wealth managers, while the cluster's median LCR is higher.

E. LCR Distribution Across Banks, at end-2024
(percent)



The NSFR metric suggests a similar ranking across bank clusters.

F. NSFR Distribution Across Banks, at end-2024
(percent)

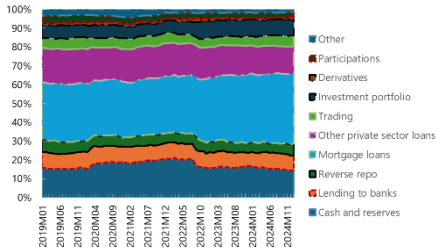


Sources: FINMA, banks' financial reports, and IMF staff calculations.
Notes: The LCR and NSFR metrics were sourced for the 92 largest Swiss banks, representing more than 90 percent of banking system assets. The SIBs cluster contains one cantonal bank, the largest one, which is a designated DSIB.

Figure 7. Switzerland: Banking System Balance Sheet

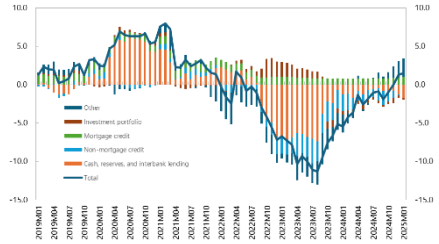
Mortgage lending represents a large and growing portion of banking system assets (30 percent end-2019, 37 percent end-24, resp. 66 percent of the loan book).

A. Total Assets—Composition
(shares in total)



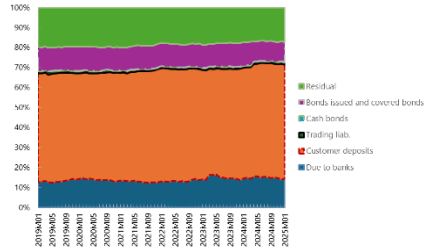
The drop in total assets late-2022-24 was driven primarily by falling cash/reserves and interbank lending, alongside contracting non-mortgage credit.

B. Total Assets—Growth and Growth Contributions
(year-on-year in percent)



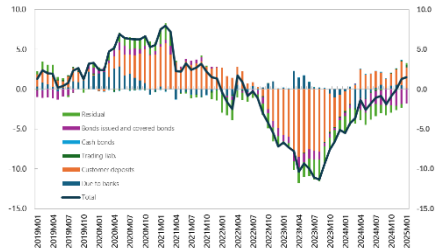
Customer deposits, interbank borrowing, own bond issuances, and mortgage bonds are the most dominant type of liabilities for banks.

C. Total Liabilities—Composition
(shares in total)



The drop in liabilities late-2022-24 was driven mostly by negative deposit growth.

D. Total Liabilities—Growth and Growth Contributions
(year-on-year in percent)

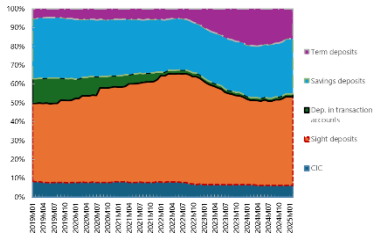


Sources: SNB and IMF staff calculations.
Notes: Total liabilities (bottom figures) include equity capital and reserves as part of the "residual," i.e., total liabilities sum to total assets here.

Figure 8. Switzerland: Monetary Developments

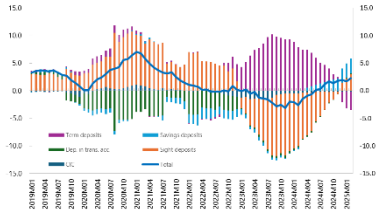
Currency in circulation amounts to 6 percent, and all forms of deposits to 94 percent, of total money.

A. Total Money—Composition
(share in total)



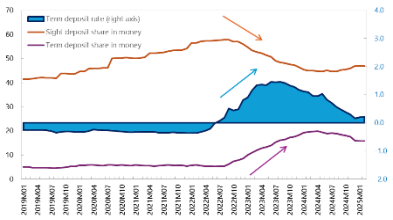
The negative money growth during 2022-24 went along with shifting sight to term deposits...

B. Total Money—Growth and Contribution
(year-on-year in percent)



...due to rising interest rates during this period, incentivizing the move to better remunerated term contracts.

C. Sight and Term Deposit Shares in Money and Term Deposit Rate
(percent)



Sources: SNB and IMF staff calculations.
Notes: The term deposit rate shown in the right chart pertains to 12-month term deposit contracts and is a mean across Swiss banks.

D. Housing Markets and Mortgage Credit

22. House price dynamics and valuation analyses suggest clear signs of overvaluation. Growth in house prices in Switzerland is explained in part by structural factors, such as immigration, and the scarcity of suitable land for construction. The SNB estimates that house price overvaluation ranges between 15–40 percent.[7] According to price-to-income and price-to-rent ratios, house prices rest by about 30 percent above historical averages (see Box 1 and figures therein). The model-based analysis suggests point estimates between 15-25 percent, while upper confidence bands, reflecting estimation uncertainty, reach up to 35 percent (Box 1).

23. Various factors fuel the creation of household mortgage debt and support its high levels in Switzerland. Such structural factors stem from tax incentives, the interplay with pension saving schemes, and lenient amortization requirements, creating an environment where maintaining high levels of mortgage debt is financially rational (from a micro, borrower perspective) and institutionally supported. Box 2 discusses this in more detail.

24. Despite the incentives for debt-based home purchases, homeownership rates in Switzerland are low in cross-country comparison. Homeownership rates currently stand at about 40-45 percent (Figure 9F.). This is low in cross-country comparison though still economically significant in absolute terms. Renting is not seen as inferior to owning, culturally and amid strong renter protection, including against arbitrary rent increases and eviction. Homeowners face a tax based on their imputed rent, while renters do not. These factors counter the drivers that incentivize mortgage debt-based home purchases. Still, the banking system's mortgage exposures are very significant, stemming from the mortgage indebted portion of the population, supported by the non- and indirect amortization schemes and tax incentive structures (Box 2).

25. Competition for banks from capital market-based lending to real estate firms is beneficial but implies risks as well. Various sizeable RE firms in Switzerland borrow largely unsecured from banks, resulting in a mostly unencumbered asset base for them (due to competition from market-based finance). This contrasts with RE firms' borrowing modalities elsewhere in Europe which more systematically involve collateral. Even though CRE lending in Swiss banks' loan books is comparably small, for some bank clusters it is more sizeable, reaching 25-30 percent of their loan books (incl. credit to firms active in the RRE market); e.g., for various cantonal and regional banks. Such lending implies risks for banks, through the ex-ante more limited and uncertain recourse to RE

[7] SNB Financial Stability Report 2024, Section 2.2. Details regarding the coverage of apartments and single-family houses should be kept in mind when comparing the estimates.

firms' assets in case they would default. The competitive market structure can, furthermore, contribute to the build-up of CRE market-wide imbalances.[8,9]

Box 1. Real Estate Market Valuation Estimates for the Swiss Housing Market

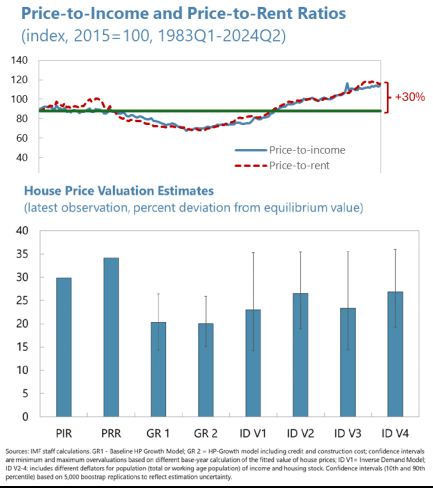
Several methodologies were employed to estimate the extent of house price overvaluation:

- *Valuation ratios*: Price-to-Income ratios (PIR) and Price-to-Rent ratios (PRR) oppose house prices to household incomes and rents. Over-/undervaluation is assessed based on the deviation of the ratios from their long-run historical averages.
- *Regression-based estimate from a model for house price growth (GR)*: The error-correction model of Igan and Loungani (2012) was employed. It relates house price growth to a set of economic variables, including growth in disposable income, credit, equity prices, the fraction of working-age population, and the level of short- and long-term interest rates, with the addition of growth in construction costs to control for supply side factors. A base version of this model excludes the latter (denoted model GR1); an extended version includes it (GR2).
- *Inverted-demand model (ID)*: Based on Muellbauer (2012), a regression model relating the level of real house prices to real income per capita, the housing stock per capita and the real long-term interest rate, aiming to thereby capture both demand and supply factors. Four variants of this model were considered, using different definitions of the independent variables (denoted ID V1-V4).

Price-to-income and price-to-rent ratios for Switzerland correlate historically and point to price levels above historical averages of about 30 percent in 2024. The upward trend started ensuing in 2002 and was not interrupted in any notable way since then.

The model-based estimates, including simulated confidence bands reflecting estimation uncertainty, suggest overvaluation estimates around 15-25 percent, while the upper bound estimates (90th percentiles) are reaching 35 percent.

A conservative estimate of the overvaluation in between the point and upper bound estimates was taken as a reference for informing the house price shocks in the adverse macro-financial scenarios (see Section on Macro-Financial Scenarios).

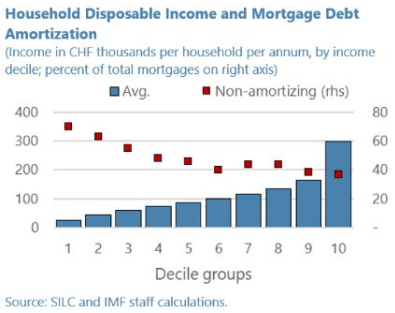


[8] The Swiss authorities monitor the risks stemming from CRE. A recent related statement can be found here: https://www.swissinfo.ch/eng/swiss-banks-risk-significant-losses-from-commercial-real-estate%2C-watchdog-finma-says/74424146?utm_source=chatgpt.com. It will be beneficial to analyze RE firms' use of secured vs. unsecured bank borrowing further, regarding possible differences in this regard with a view to RE firms' size for example, by examining publicly available data from RE firms' financial reports alongside supervisory reporting from the banks' perspective at FINMA's disposal.

[9] An IMF Selected Issues Paper from June 2024, titled "Real Estate Markets and Vulnerabilities: The Case of Switzerland" (link) provides additional information regarding real estate market structures and the role of CRE firms in Switzerland.

Box 2. Structural Factors Supporting High Household Mortgage Debt

A high share of mortgage debt in Switzerland is not amortizing, particularly among lower-income mortgage borrowers. The share of such non-amortizing debt for borrowers in the lowest income buckets reaches up to 70 percent (chart on the right). This is one reason for the structurally high household mortgage debt balances outstanding for the Swiss banking system.



The outstanding non-amortizing mortgage loans result from total mortgage debt at household level often being divided into a non-amortizing and an amortizing part. A first mortgage, up to two thirds of the lending value[1], does not need to be amortized. Borrowers can carry such first mortgage debt in principle indefinitely, paying only periodic interest. A second mortgage, the part of mortgage debt exceeding two thirds of the lending value, is to be repaid within 15 years or latest by the time of retirement (whichever comes first). Further, for the amortizing second mortgage, borrowers can choose an "indirect amortization scheme," i.e., a tax-advantaged Pillar 3 pension savings scheme.[2] That is, they can use the accumulated savings therein to repay the principal debt of the second mortgage at the end of the loan contract or latest by the time of retirement. This resembles a "bullet loan" scheme known in other countries, though the difference is that the Pillar 3 savings scheme in Switzerland appears more institutionalized and the savings are being pledged explicitly for the second mortgage. **Against this background, there are five factors that support mortgage debt creation, accumulation, and its maintenance at high levels in Switzerland.** These include:

(1) At origination, mandatory pension savings (Pillar 2) and voluntary pension savings (Pillar 3) can be pledged for mortgage borrowing, allowing higher leverage than otherwise.

(2) At origination, 10 percent of the lending value of the property must be covered by the borrower's own funds. The remaining part of the down payment can be covered by depleting Pillar 2 or 3 savings (for Pillar 2, up to 100 percent of the savings until age 50; the higher of up to half of it or the amount at 50 after age 50).

(3) The option to have up to two thirds of total lending value not amortizing.

(4) Pillar 3 savings can be used for the aforementioned "indirect amortization," i.e., borrowers do not repay principal to the bank but save in a Pillar 3 scheme, to use the savings to repay the mortgage at maturity. Borrowers thereby retain tax benefits from interest deductibility and generate interest income and capital gains from the Pillar 3 investments.

(5) Interest on mortgage debt is tax deductible against income, thereby further subsidizing the cost of carrying mortgage debt.[3]

The non-amortization and indirect amortization schemes imply various risks. These include the tendency for structurally high indebtedness and continuous structural upward pressure on housing demand, and therefore valuations. It means credit risk for borrowers at the time when principal comes due, in case the Pillar 3 schemes involve higher shares of more risky security investments whose value may drop (even though unlikely so). The combination of high household leverage and concentrated mortgage lending raises the risk of a housing-led financial crisis and procyclicality. The associated vulnerabilities should be carefully monitored, and preventive policies that contain household indebtedness and debt service burden be considered well in advance.

Box 2. Structural Factors Supporting High Household Mortgage Debt in Switzerland
(Concluded)

The terminology "lending value" is used here to denote the value of the purchased real estate at origination, which is the lower of the market value and purchase price. For details, see link.

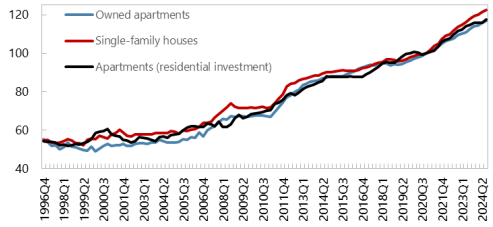
[2] In Switzerland, Pillar 1 pertains to a mandatory government-managed pension, providing a subsistence pension. Pillar 2 denotes mandatory occupational pensions. Pillar 3 comprises voluntary pension savings, featuring withdrawal restrictions and tax deductibility.

[3] Switzerland appears to be the only country internationally that levies an income tax on a fictitious income from home ownership. This is one reason why homeowners prefer to not amortize mortgage debt. A fully amortized home would result in taxable income from the fictitious income but no interest that could be netted against it.

Figure 9. Switzerland: Housing Market Developments

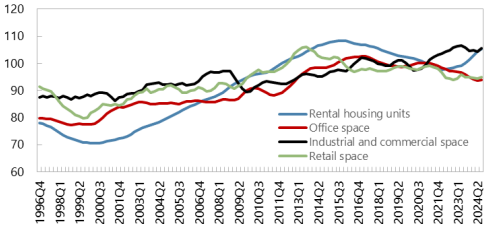
Residential property prices keep growing without any notably downturns since decades.

A. Residential Property Prices (Transaction Prices)
(indexes, 1996Q4-2024Q3, 2020Q4=100)



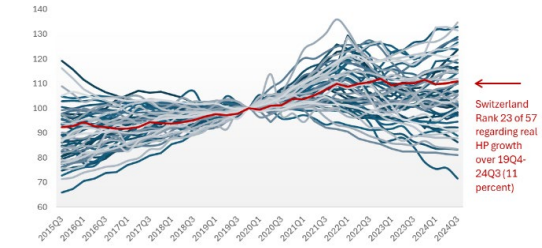
Commercial property rent prices move rather sidewards in various commercial sub-segments.

B. Commercial Property Prices (Rent Prices)
(indexes, 1996Q4-2024Q4, 2020Q4=100)



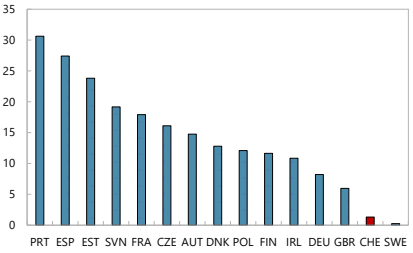
House price growth in Switzerland over the past five years amounted to about 11 percent in real terms.

C. Real Residential House Price Growth Across Countries
(indexes, 2019Q4=100)



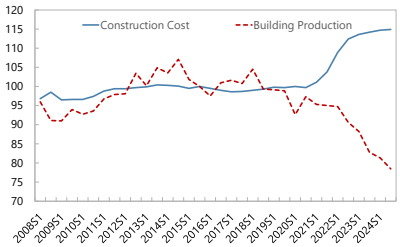
Vacancy rates are low in cross-country comparison, pointing to supply side strains.

D. Vacant Dwellings Across Countries
(percent of total stock, latest available year, 2022 for CHE)



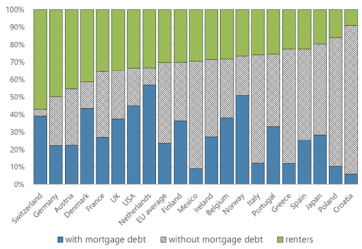
While construction costs are stabilizing, actual construction keeps contracting.

E. Construction Activity and Cost
(indexes, 2015S2=100)



Switzerland has comparably low homeownership rates, and those who do own, involve mortgage credit.

F. Home Ownership Across Countries
(percent of total households)



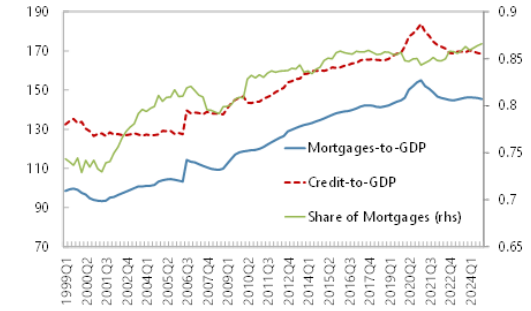
Sources: Wuest Partner, IAZI, OECD, SNB, FINMA, banks' financial reports, Haver Analytics, FSO, and IMF staff calculations.

Figure 10. Switzerland: Mortgage Credit and Debt Service Metrics

Mortgage credit constitutes are large share in total credit, with its growth having slowed recently.

A. Evolution of Credit and Mortgage Credit

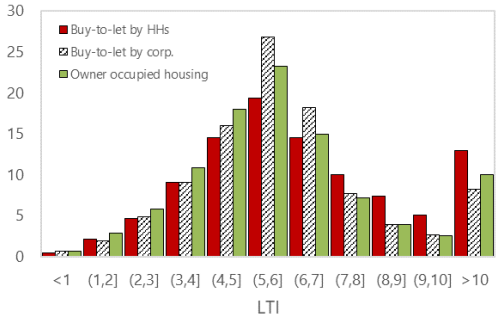
(percent; percent of mortgages in total credit on right axis)



Loan-to-income ratios are higher for private households' buy-to-let activity.

B. LTI Distribution by Segment

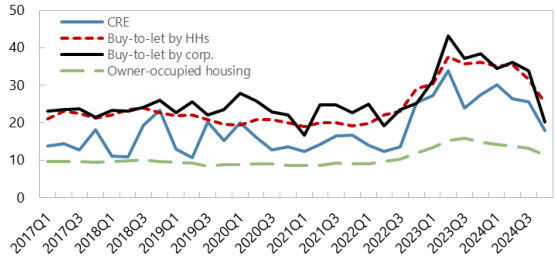
(percent of total new mortgages by segment, 2017-24 pooled)



DSTIs are higher for buy-to-let business, and for all segments they follow interest rate developments.

C. DSTIs by Segment

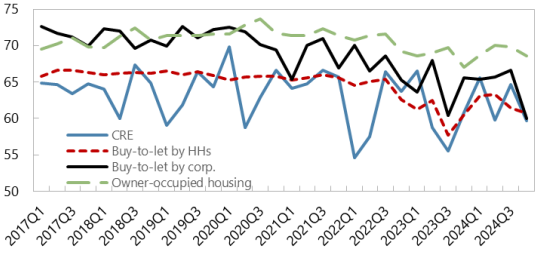
(percent; for new business and refinancing per quarter)



LTVs at origination are highest for owner-occupied housing, while LTVs for CRE are most volatile.

D. LTVs by Segment

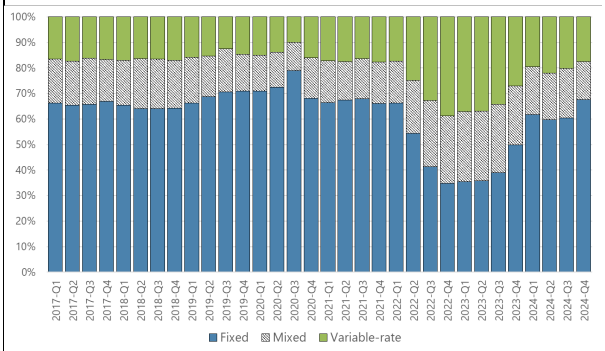
(percent; for new business and refinancing per quarter)



Variable rate shares move up when interest rates move up.

E. Rate Types for Newly Granted Mortgages for Household Owner-Occupied Real Estate

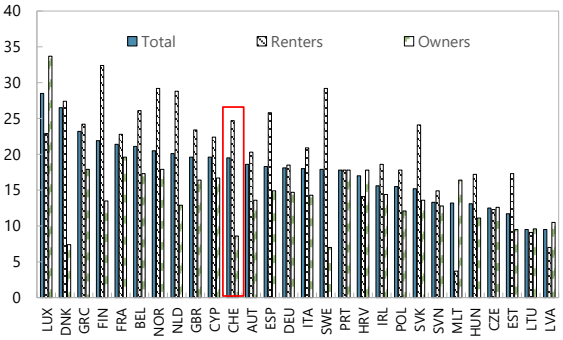
(percent of total new owner-occupied mortgages)



Housing costs for owners are comparably low due to the elevated share of non-amortizing mortgages.

F. Housing Cost Burden Across Countries

(mortgage and rent cost as share of disposable income)



Sources: SNB, FINMA, banks' financial reports, Haver Analytics, Eurostat, OECD, and IMF staff calculations.

Note: More data related to LTVs and DSTIs for new mortgage lending are collected in Figures A4 and A5 in Appendix A.

RISKS, VULNERABILTIES, AND MACRO-FINANCIAL SCENARIOS

A. Risks and Vulnerabilities

26. The financial system is vulnerable to real estate market corrections and interest rate shocks. Real estate lending represents a sizeable share of bank lending (>70 percent of the loan book). Variable rate mortgage shares have risen to 20 percent and bank credit standards tended to loosen recently (see previous section). Real estate-related investments are significant also in insurers' investment portfolios (31 percent for life insurers) and for pension funds (23 percent of their assets). House price valuations are notably stretched. Should a housing market downturn materialize, loss given default (LGD) parameters for banks would spike, pushing loss provisioning needs up and thereby pressuring bank solvency. Default probabilities may rise in particular in the CRE segment, and cause losses for banks to realize.

27. The Swiss economy is vulnerable to external demand and global supply shocks. External demand for the goods and services that Switzerland exports would adversely react to trade policy shocks and deepening geoeconomic fragmentation. A material supply shock, if it were to materialize, would trigger inflation pressure at global level, the risk of de-anchoring inflation expectations, and hence the tendency for central banks to increase interest rates, which burdens variable rate borrowers and security valuations. The Swiss nonfinancial corporate sector would suffer from diminished export-based income, including due to safe haven-induced CHF appreciation, alongside rising borrowing costs for the affected firms, thereby leading to corporate defaults and associated loan losses for banks.

28. Material concentration risks result from the now-even-more-systemic UBS Group. After its takeover of CS, UBS became the world's largest G-SIB relative to domestic GDP. UBS provides critical functions for the Swiss financial system and the economy. It is globally systemic, being exposed to international clients and markets. UBS is a central node in Switzerland's domestic as well as the global financial system. Compared to other peer G-SIBs, UBS outranks them in metrics of complexity, cross jurisdictional activities, and interconnectedness (Appendix A, Figure A7).

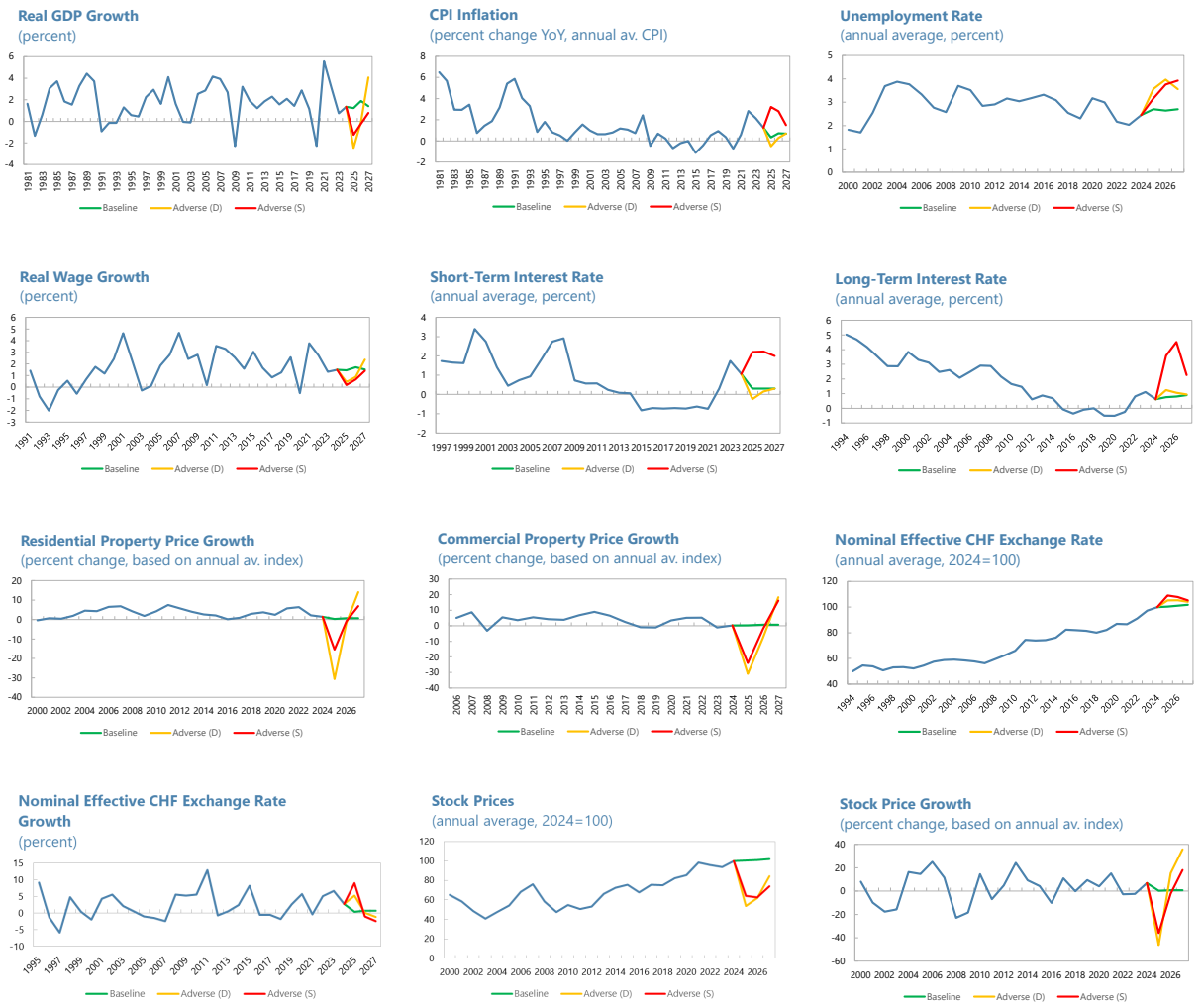
B. Macro-Financial Scenarios

29. The systemic risk analysis, including the stress tests for banks and insurers, was based on macrofinancial scenarios with a three-year horizon from 2025–27 (Figure 11 and Appendix C). The baseline scenario is aligned with the IMF WEO (an intermittent IMF-internal one as of February 2025). Two adverse scenarios were developed, with their narratives being informed by the Risk Assessment Matrix (RAM, Appendix B), intertwined with the macro-financial vulnerabilities as laid out above.

30. The two adverse scenarios include a demand shock-dominated disinflationary scenario and a supply shock-dominated inflationary scenario. Both scenarios have a global component

that assumes a deepening of geoeconomic fragmentation and materialization of global risks. The geopolitical risk materialization scenario, a supply shock scenario, entails an increase in monetary policy rates to counter inflationary pressures, while the demand shock scenario involves a reduction in policy rates. Housing markets are assumed to experience a downward correction under both scenarios, whose severity was informed by the disequilibrium analysis presented earlier in this note.[10]

Figure 11. Switzerland: Macro-Financial Scenarios



Sources: IMF WEO and IMF staff calculations.
Notes: The scenario horizon spans the three year period from 2025-27. Adverse (D) denotes the demand shock scenario. Adverse (S) denotes the supply shock scenario. An extended set of scenario features can be found in Table C1 in Appendix C.

[10] The SNB considers four adverse scenarios in its recent Financial Stability Reports. These include three demand shock scenarios, with different geographical foci (global vs. EMEs vs. euro area) and one inflationary scenario with rising interest rates. The FSAP demand shock scenario's narrative can be seen—narrative-wise—as a combination of such three geographically differentiated demand shock scenarios.

31. The scenario severities reflect a business cycle-state dependent rationale. The standard deviation multiples based on real GDP growth relative to historical mean growth for year 1 and cumulative 2 years amount to 2.4x and 2.3x for the demand shock scenario, and 1.7x and 1.9x for the supply shock scenario. In a multivariate sense, the supply shock scenario is adequately severe because inflation and interest rates experience upward pressure, which is less common historically.

BANK SOLVENCY RISK ANALYSIS

A. Solvency Stress Test Sample and Methodology

32. The bank stress test sample comprised SIBs, cantonal banks, private banks engaged in asset and wealth management, and a long tail of regional banks. The sample for solvency and liquidity stress testing as well as for interconnectedness analysis included a common sample of 92 (112) banks at consolidated (solo) level, covering 93 percent of Swiss banking system assets at end-2024. The sample included four SIBs (one of which is the aggregate Raiffeisen bank holding), 23 cantonal banks (a 24th being part of the SIBs cluster), 12 asset and wealth management banks, 42 regional banks including cooperatives, and 11 other banks.

33. The solvency stress test model combines various structural and econometric model elements developed for the Swiss banks. Regarding credit risk, seven portfolios were defined for which PD and LGD models were developed (Table 2). These include econometric model components for the PDs separately of NFCs, CRE firms, banks, and NBFIs (Appendix E). They involved data for 432 Swiss firms, from Moody's Credit Edge, for their estimated PDs, leverage, and other metrics. A Bayesian Model Averaging (BMA) methodology[11] was used to relate the PDs to macro-financial variables, for their use for scenario conditional forecasting and feeding the solvency stress test model.

34. For the banks' sizeable household mortgage portfolios, a micro-macro simulation model was set up. This involved confidential micro data from the Swiss Federal Statistics Office (FSO)' SILC survey and other supplementary data, covering 8,900 households and 19,229 household members. Involving a micro data-based structural model[12] (Appendix F) based on such data was instrumental because no historical data for household default rates are available to the Swiss authorities (nor LGDs). Historical conditions in Switzerland were, moreover, such that default rates were very low, as seen through low NPL stock formation and limited write-offs. These facts combined imply the appeal of structural models, anchored in micro data.

35. The household simulation model was used for three purposes. Its role was (1) to compute the scenario conditional PD paths for the retail mortgage portfolios and consumer credit, and the LGDs for the mortgage segment, as input to the bank solvency stress test; (2) to conduct counterfactual simulations in the macroprudential policy context[13]; and (3) to build in a climate

[11] Gross and Población (2019, link).

[12] The model of Gross and Población (2017, link) and Gross et al. (2022, link) was employed. See Appendix F.

[13] See the separate FSAP Technical Note on Macroprudential Policy and Real Estate Risks.

model overlay to assess how household risk parameters change under physical climate risk materialization scenarios.

Table 2. Switzerland: Bank Solvency Stress Test—Model Components at a Glance

Model Component	Comments	
Interest expense and income	Panel econometric bridge equations relating banks' cost of funding to market and policy rates, banks' own capital ratios, and for cross-border active banks including interest rates from respective other jurisdictions. Panel models per cluster of banks and split further in domestic and cross-border active sub-clusters. For interest income rates, dependence on market and policy rates, banks' own cost of funding, and for cross-border active banks including interest rates from respective other jurisdictions. Nonperforming exposures do not generate interest income.	
Credit risk	**PD**	**LGD**
NFC excl. CRE	BMA for PDs from Moody's Credit Edge (CE) at sub-sectoral level. Involving data for 432 firms from Moody's CE, split in the four firm clusters as listed here on the left.	Frye-Jacobs
Banks		
NBFI		
CRE		Link to commercial property prices under scenario, at bank-portfolio level
Household mortgages	Structural micro-macro simulation model (IDHBS+)	IDHBS+, link to residential property prices under scenario at micro level
Consumer credit		Frye-Jacobs
Foreign RE-backed & other	Scaling approach, involving domestic RE portfolios' PD paths and scenario severity	Frye-Jacobs
Fee & commission income and expense	Panel BMA relating fee & commission income and expense ratios to macro-financial conditions. Per cluster of banks. Fee & commission expense relative to total assets held constant. Fee & commission income (FCI) pertaining to banks' asset and wealth management taken as ratio to off-balance sheet assets under management. Other FCI components, e.g., related to credit provision, relative to total assets gross of provisions (quantitatively less relevant), modeled through move into bank own distributions' historical tails.	
Market risk	Bonds in HFT and AFS portfolios revalued using modified duration approach, as function of bank-bond-portfolio durations and interest rate trajectories (base rates and credit spreads) from the scenario. An interpolation scheme was embedded for the yield curve position and associated stress under the scenarios, for each bank bond portfolio. Banks' exposures via collective investment schemes were distributed proportionally to their bond/equity portfolios. Participations and equity revalued in line with equity price trajectories. SNB's models for SIBs, while results from the FSAP market risk module were compared to SNB model results.	
Non-interest expenses	Residual P&L item up to net income before tax. Ratio to total assets gross of provisions held constant.	
RWA and credit growth	RWs for IRB bank portfolios modeled with IRB RW formulas. General loan growth on top. For STA portfolios: migration effects from performing to nonperforming drive RW changes.	

Sources: IMF staff.
Note: More information about the solvency stress test model and its components can be found in Appendices D-G.

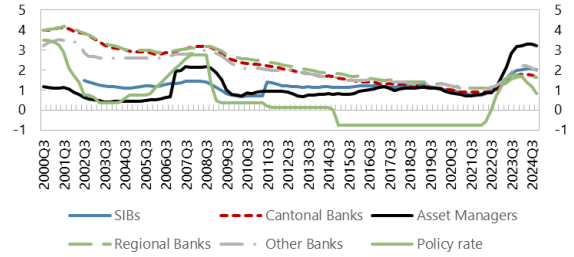
36. Econometric models, structurally informed, were set up for banks' interest income, expense, and fee and commission income. The interest expense models account for the pass-through from policy and market rates to banks' interest expense and allowed for feedback from bank solvency to their cost of funding, which was found to be relevant for various bank clusters. The interest income models account for the pass-through from policy and market rates, banks' own cost of funding, and macro-financial variables driving a credit spread component (Appendix G). The fee and commission income models were set up using a panel version of the aforementioned BMA methodology (Appendix H). Some related data that the models were based on is shown in Figure 12.

Figure 12. Switzerland: Bank Interest Income, Expense, and Fee & Commission Income

Interest income rates had converged around 1.4 percent across bank clusters over 2017-23.

A. Interest Income Rates

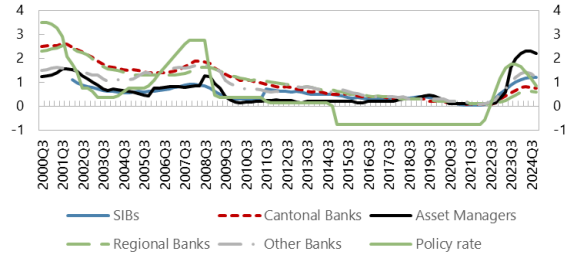
(percent; median across banks per cluster per quarter)



Banks' cost of funding had approached 10-20 bps in 2021, before decompressing to levels of 1-2 percent.

B. Cost of Funding

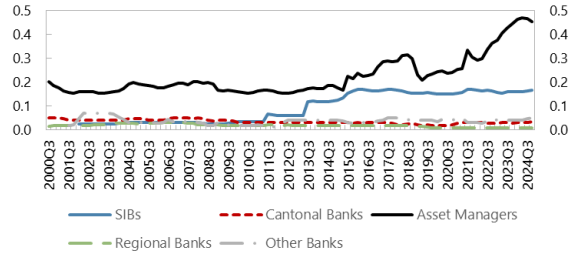
(percent; median across banks per cluster per quarter)



Fee and commission expenses are most sizeable and recently rising for the asset and wealth managers.

C. Fee and Commission Expense Ratios

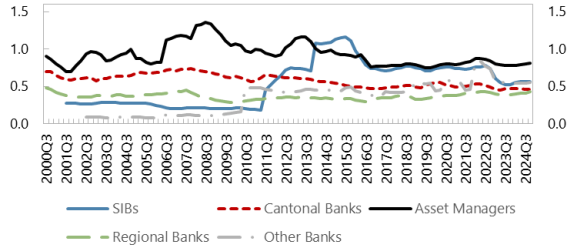
(percent; median across banks per cluster per quarter)



Fee and commission income from managing customer funds are most relevant for asset managers and SIBs.

D. Fee and Commission Income Ratios—Investment Services (relative to AUM)

(percent; median across banks per cluster per quarter)



Sources: SNB, FINMA, and IMF staff calculations.

Notes: The data underlying the charts in this panel are for 92 Swiss banks (consolidated group level), which represent 93 percent of banking system assets at end-2024. All flow measures involved in the numerators of the ratios in all six charts are 4-quarter trailing sums. All denominators are four-quarter trailing averages of interest-bearing assets A., liabilities excl. equity B., total assets C., and assets under management D.. The last observations are all for 2024Q4.

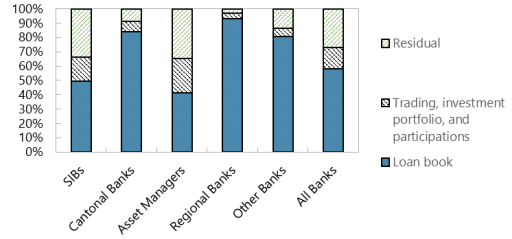
37. A market risk module was set up for revaluing banks' trading and investment portfolios. The bank level exposure data provided by FINMA and SNB were processed to result in 13 segments, with a split between participations, money market investments, bonds, shares, a domestic vs. foreign dimension, and a split between sovereign, financial, and NFC bonds. A modified duration formula was used to revalue all bond portfolios, conditional on the interest rate shifts in the scenario. For the SIBs, SNB's models were used to account for numerous features, including hedging.[14] Only the HFT and AFS portfolios were revalued, i.e., HTM bond portfolios were not marked-to-market (a sensitivity analysis was conducted separately in this regard). The market risk impacts were defined as instantaneous, using the shock profiles reported in Tables C1 and C2 (Appendix C). Additional data regarding the banks' loan books and trading and investment portfolios, relevant for the solvency stress test, is shown in Figure 13.

[14] SNB's market risk-related models are well developed and advanced, and account, for example, for delta and gamma risks, correlation and dividend risks, spread risks, shocks to synthetic spread exposures to capture basis risks, and valuation risks (PVA risks). The latter were not captured through top-down models but through UBS's bottom-up calculations in this regard.

Figure 13. Switzerland: Banks' Loan Book, Trading and Investment Portfolios, and Selected Related Parameters

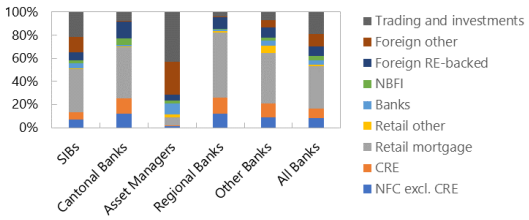
The trading and investment portfolios are notably more sizeable for SIBs and asset/wealth managers.

A. Balance Sheet Structure
(share in total, end-2024)



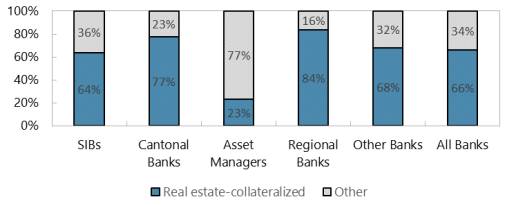
The most relevant exposures include retail mortgages, followed by trading/investments, incl. Lombard loans.

B. Loan Book and Trading & Investment Portfolios
(share in total, end-2024)



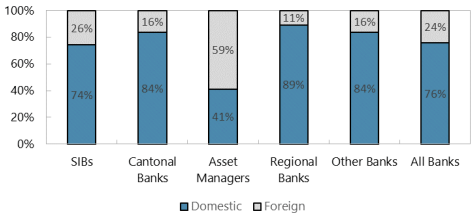
Regional and cantonal banks are yet more exposed to real estate than the other bank clusters.

C. Real Estate-Collateralized vs. Other Lending
(share in total loan book, domestic and foreign, end-2024)



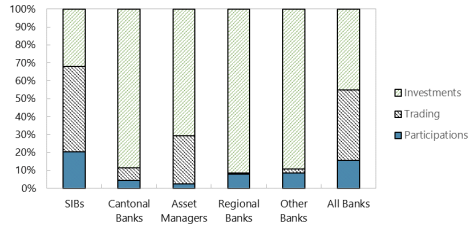
SIBs and asset/wealth managers have more sizeable foreign exposure loan book shares.

D. Domestic vs. Foreign Loan Book
(share in total loan book, end-2024)



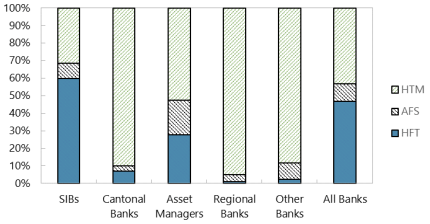
The securities holding shares in the trading book are visibly higher for the SIBs.

E. Participations, Trading, and Investment Portfolios
(share in total, end-2024)



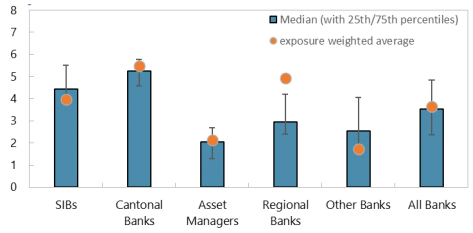
The investment portfolio of banks (i.e., AFS+HTM) is predominantly held under HTM.

F. HFT, AFS, and HTM
(share in total, end-2024)



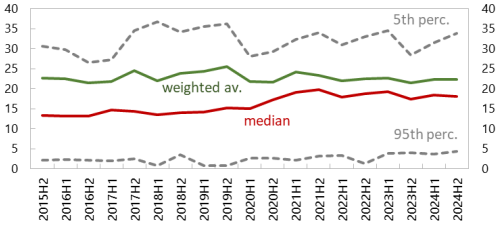
Bond durations in the investment portfolios are longer for cantonal and large regional banks.

[G] Residual Duration of Bond Investment Portfolios
(years, end-2024)



Lombard loan exposures are notable for asset/wealth managers, with their relevance being steady over time.

[H] Lombard Loan Exposures of Asset and Wealth Management Banks
(share in total assets, in percent, end-2024)



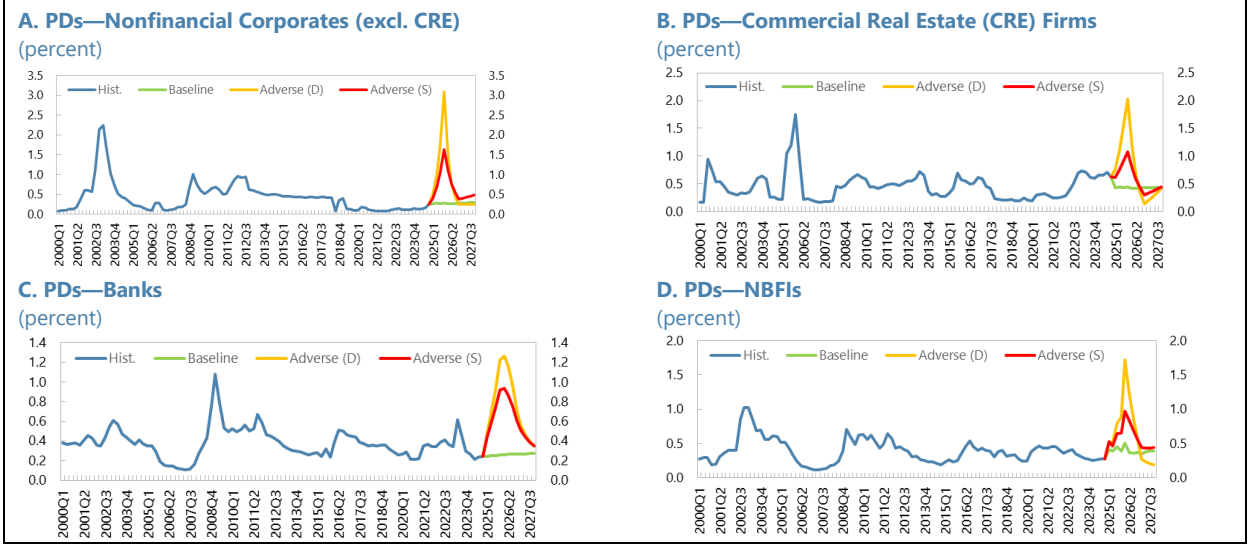
Sources: SNB, FINMA, banks' financial reporting, and IMF staff calculations.
Notes: The data underlying the charts in this panel are for 92 Swiss banks (consolidated group level), which represent 93 percent of banking system assets at end-2024.

B. Corporate and Household Sector Model Inputs

38. The corporate and household sector models provided the risk parameter inputs into the solvency stress test. The scenario conditional PD forecasts (Figure 14) from the various portfolio-specific models result in notable default materialization under the adverse scenarios. For portfolios other than household mortgages and consumer credit, the demand shock scenario causes more pronounced PD hikes. This is because the relevant drivers, such as GDP growth, unemployment, and house prices are more adverse in the demand than in the supply shock scenario. The supply shock scenario is more detrimental for household mortgages and consumer credit due to the rising interest rates and the household borrowers elevated interest rate sensitivity. Factors such as unemployment matter somewhat less for Swiss households in a default risk context, because of a supportive unemployment benefit scheme (with wage replacement rates exceeding 70 percent initially after job loss). Further, household mortgage PDs are not reacting directly to residential house price drops (reflected in the structural IDHBS model for its application to Switzerland) because incentives for strategic default—in case of negative equity—are rather absent due to a full recourse system prevalent in Switzerland.[15]

39. LGD responses are particularly pronounced for the real estate collateralized portfolios, consistent with the material house price drops in the adverse scenarios. Household mortgage LGDs rise from about 10 percent to 30 percent under the demand shock scenario (Figure 15). CRE portfolio LGDs rise from 15 percent to more than 50 percent at the peak.

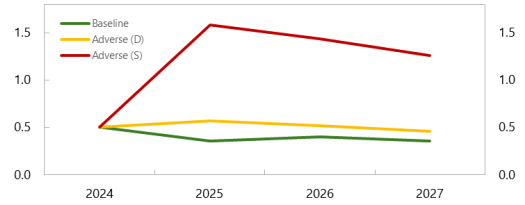
Figure 14. Switzerland: PD Trajectories for Various Bank Portfolios



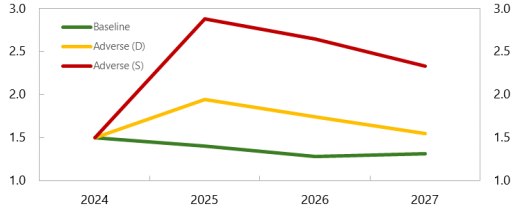
[15] The adverse-baseline gap of mortgage PDs is quantitatively explained as follows: under the demand shock scenario, the gap stems from contributions of all structural drivers in about comparable quantitative terms (rising unemployment rate, falling wages, and somewhat stronger nominal consumption expenditure; while falling interest rates imply a positive contribution, a relief, for PDs). Under the supply shock scenario, the two most notable contributions stem from rising interest rates, followed by yet stronger nominal consumption expenditure, the latter aligning with the strong inflationary shock in that scenario. Both factors would adversely affect the debt service ability of households.

Figure 14. Switzerland: PD Trajectories for Various Bank Portfolios Concluded

E. PDs—Household Mortgages
(percent)



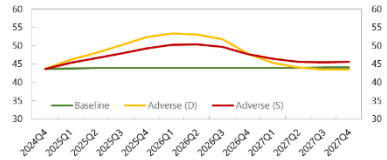
F. PDs—Consumer Credit
(percent)



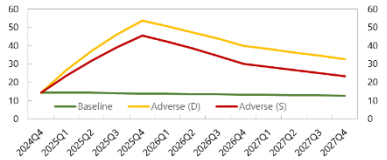
Sources: SNB, FINMA, Moody's, and IMF staff models and calculations.
Notes: All PDs are annual rates. The scenario horizon spans the 2025(Q1)-2027(Q4) period. Adverse (D) and (S) denote the demand and supply shock scenarios, respectively. For the underlying models, see Appendices E and F.

Figure 15. Switzerland: LGD Trajectories for Various Bank Portfolios

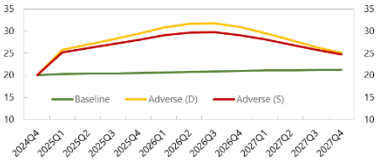
A. LGDs—Nonfinancial Corporates
(percent)



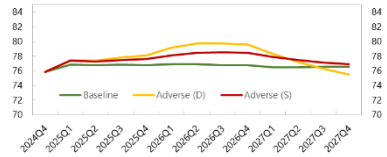
B. LGDs—Commercial Real Estate
(percent)



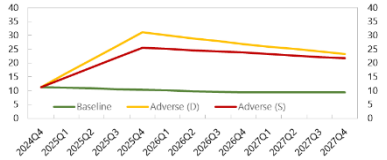
C. LGDs—Banks
(percent)



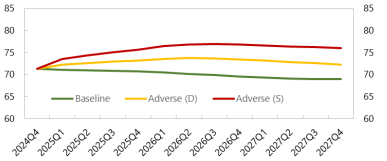
D. LGDs—NBFIs
(percent)



E. LGDs—Household Mortgages
(percent)



F. LGDs—Consumer Credit
(percent)



Sources: SNB, FINMA, and IMF staff models and calculations.
Notes: The LGDs for NFCs, banks, NBFIs, and consumer credit were modelled using the Frye-Jacobs method. For the LGDs for CRE and household mortgages, the models entail a link to commercial and residential property prices in the scenario.

C. Solvency Stress Test Results

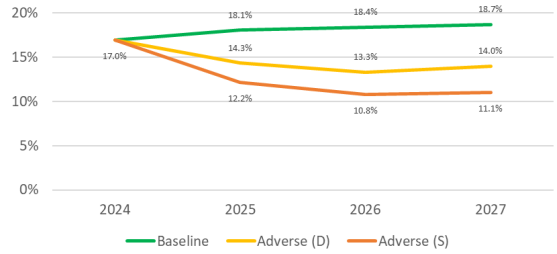
40. The Swiss banking system was found to be resilient at large. The aggregate CET1 capital ratio of 92 banks moves from 17 percent at end-2024 to 10.8 percent at the trough (Figure 16). For most banks, the low point is the first or second year of the supply shock scenario. Cantonal banks' solvency is, according to the estimates, least affected (-4.3 pp). The starting point CET1 capital ratio of asset managers is the highest in cross-cluster comparison (20 percent) but also drops most visibly (-13.6 pp). SIBs aggregate CET1 ratio also drops considerably (-6.3 pp), but all remain above hurdle rates.

41. Several factors contribute to the decline in capital ratios under the adverse scenarios. Up to the third year (end-2027) under the supply shock scenario, the bank system capital impact is driven by a combination of loan losses (-4 pp difference between adverse and baseline in 3-year cumulative terms), followed by fee and commission income (-2.2 pp), trading income (-1.7 pp), and net interest income (-1.4 pp), (Figure 17).

Figure 16. Switzerland: Bank Solvency Stress Test Results

The capital ratio of the aggregate sample of 92 banks drops by 6.2 p.p. to the low point in Year 2.

A. CET1 Capital Ratios at Banking System Level
(percent)



The solvency impacts differ by bank clusters, due to differential business models and implied sensitivities.

B. CET1 Capital Ratios—From T0 to Trough
(percent)

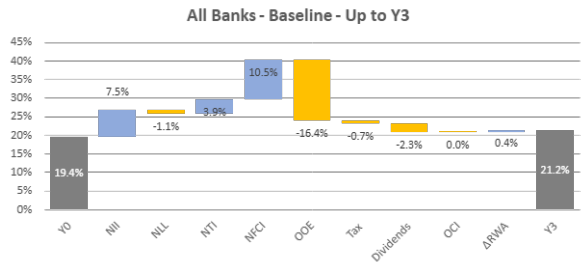
Sources: FINMA, SNB, banks' financial reports, and IMF staff models and calculations.

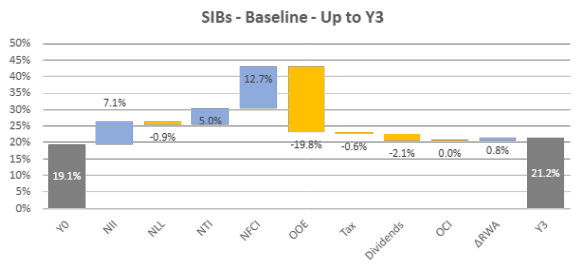
42. The drivers of capital depletion are heterogenous across bank clusters. The impact from loan losses is driven mainly by deteriorating retail mortgage portfolios, with a strong impact on regional banks, cantonal banks, and other smaller banks (Figure 17 and 18). Rising interest rates, associated with the supply shock scenario, propagate through higher funding costs, higher loan losses stemming from variable rate borrowers, and bond valuation losses (smaller effect for the banks with notable trading and mark-to-market investment portfolios due to hedging). Additional losses stem from Lombard loans, linked to international business, which is relevant for asset and wealth managers and the SIBs group. The adverse impact from fee and commission income and trading is pronounced for the asset and wealth managers. This result needs to be interpreted with caution, however, due to sizeable model and parameter uncertainties specifically regarding the asset and wealth management banks.[16]

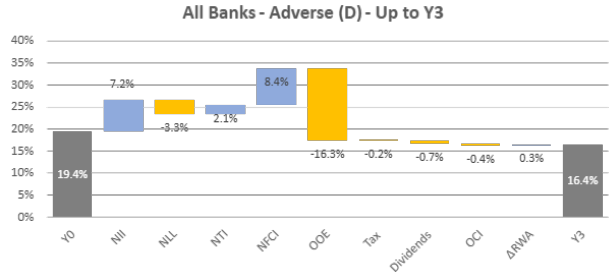
43. Some banks fell short of the defined hurdle rates. Hurdle rates in the adverse scenarios were defined as regulatory minimum capital requirements (Pillar 1), plus Pillar 2 requirements, and systemic surcharges for the four SIBs. The CCoB and CCyB were allowed to be consumed under the stress scenarios. Five of 92 banks fall below the CET1 hurdle rate by the third year of the supply shock scenario. Regarding total capital ratios, six banks fall short of the hurdle rate. These banks' combined assets represent 4.6 percent of banking system assets at end-2024. Their combined CET1 capital shortfall amounts to 0.4 percent of GDP under the supply shock scenario's third year (and 0.04 percent of GDP under the demand shock scenario). These shortfall indications are driven by the aforementioned asset and wealth management cluster of banks, which is surrounded by non-negligible model uncertainties.

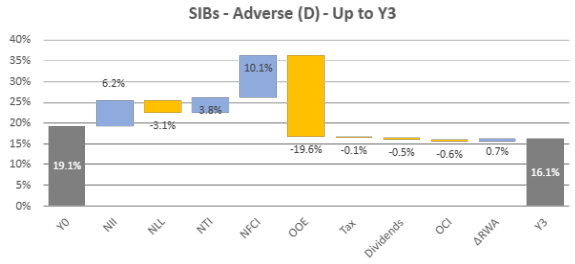
[16] Conservative assumptions had to be made in lack of data/information. Gaps and implied caveats include (1) uncertainty regarding the starting point risk parameters for those banks' sizeable Lombard loan exposures, e.g., regarding their LGDs; (2) the extent of hedging of these banks' trading and investment portfolios; and (3) challenges related to the specific dynamics of fee and commission income for this bank cluster.

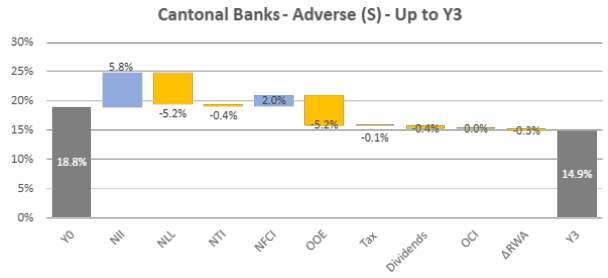
Figure 17. Switzerland: Bank Solvency Stress Testing—Capital Contribution Analysis

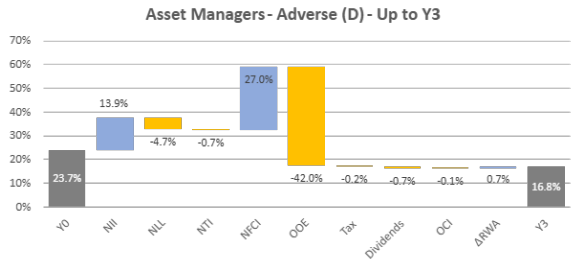


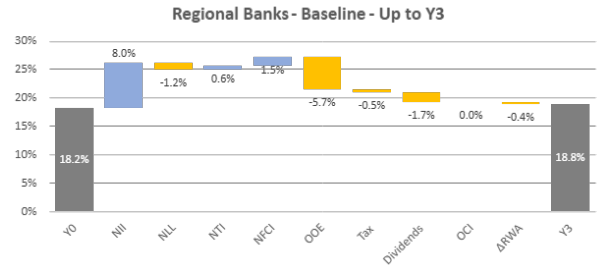


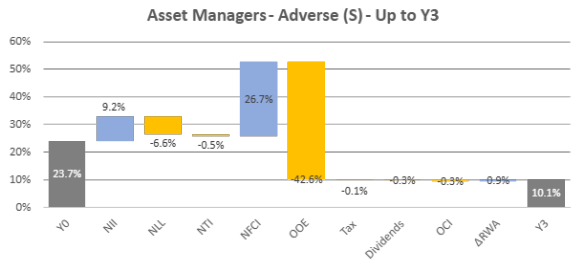


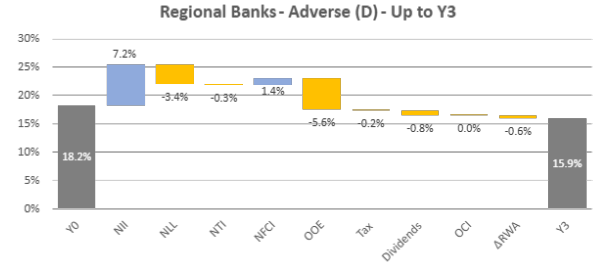












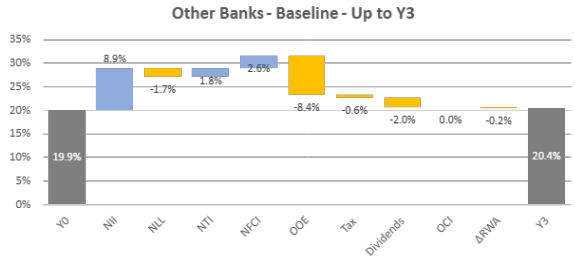


Figure 17. Switzerland: Bank Solvency Stress Testing—Capital Contribution Analysis (Continued)

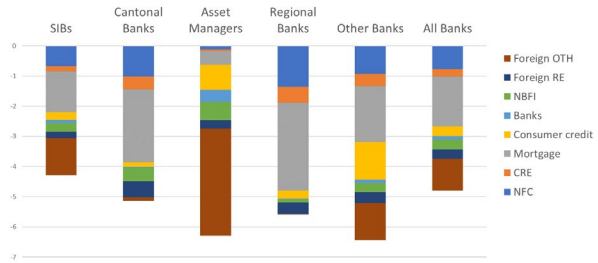
Sources: FINMA, SNB, banks' financial reports, and IMF staff calculations.

Note: The charts show the evolution of the total capital ratios of the bank clusters and the three scenarios (baseline, demand shock, and supply shock scenario). The contributions, in p.p., that drive the Year-0 (end-2024) capital ratios forward, here in cumulative terms to Year-3 (end-2027), include: NII = net interest income, NLL = net loan loss, NTI = net trading income, NFCI = net fee and commission income, OOE = other operating income (a residual P&L item up to pre-tax net income), and OCI = other comprehensive income.

Figure 18. Switzerland: Bank Solvency Stress Test—Loss Contributions & Other Metrics

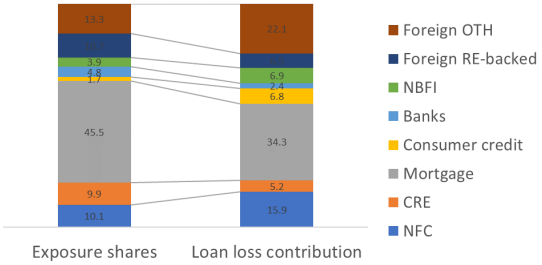
Loan losses stem from the banks' sizeable retail mortgage loan portfolios, while additional losses for asset and wealth managers may arise from Lombard loans (though uncertain regarding their underlying risk parameters).

A. Loan Loss Contribution to Capital Ratio Shifts
(from year 0-3 in p.p.; supply shock scenario, all banks)



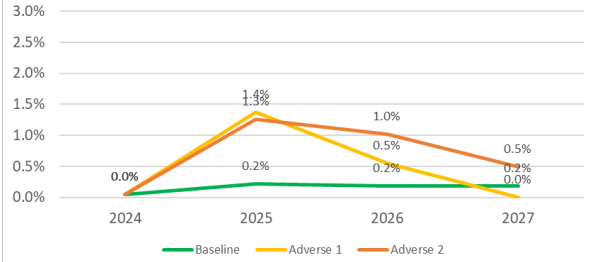
The loss contribution from mortgage lending relative to their portfolio size, is smaller than for other portfolio segments.

B. loan Book Composition vs. Loan Loss Contributions
(loss contributions cumul. Year1-3; supply shock; all banks)



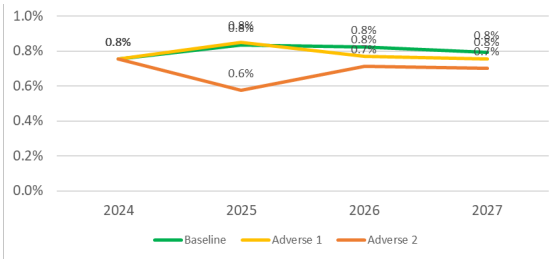
The portfolio-aggregate loan loss rates at banking system level rise sharply in Year 1 and are more persistent in the supply shock scenario.

C. Net Loan Loss Rates
(annual loan loss flow over gross loans end of previous period)



Net interest income drops notably in the first year of the supply shock scenario due to rising funding costs, alongside more intense defaults of variable rate borrowers.

D. Net Interest Margins (NIM)
(annual net interest income over interest bearing assets)



Sources: FINMA, SNB, banks' financial reports, and IMF staff models and calculations.

44. A sensitivity analysis for the revaluation of banks' HTM bond portfolios results in economically relevant capital impacts. The impact of optionally revaluing banks' HTM bond holdings is most visible under the supply shock scenario (Figure 19), given the rising short- and long-term interest rates in that scenario. For asset and wealth managers, the impacts are pronounced but subject to the earlier mentioned caveat, that hedging could not be fully accounted for. The capital impacts for cantonal and regional banks amount to -1.5 and -0.9 p.p., respectively (Figure 19). These impacts are visible despite these bank clusters having smaller investment portfolios (Figure 13A.), due to most of it being held under HTM (Figure 13F.) and them having longer durations (Figure 13[G]), resulting in non-negligible capital impacts despite the smaller portfolio size.

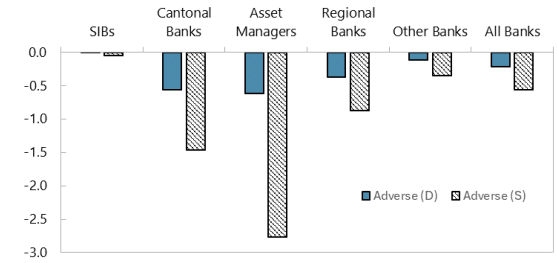
45. A sensitivity analysis regarding solvency-to-cost-of-funding channel reveals a cluster-dependent role for this feedback. This feedback was found to be quantitatively and economically non-negligible for banks from many clusters, and particularly for asset and wealth management banks and regional banks, where the feedback explains between 40-50 bps of the adverse-baseline gap of the banks' capital ratios at the low point (Figure 19).

Figure 19. Switzerland: Bank Solvency Stress Test—Sensitivity Analyses

Revaluing banks' HTM bond portfolios shifts the capital ratios visibly for various clusters of banks.

A. Capital Ratio Shifts Resulting from Marking-to-Market Banks' HTM Bond Portfolios

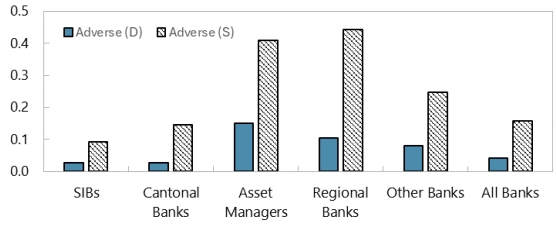
(percentage points; on top of adverse scenarios, at low point)



Switching the solvency-to-cost-of-funding feedback off results in less severe capital impacts for some bank clusters.

B. Capital Ratio Shifts Resulting from Switching Off Solvency-to-Cost-of-Funding Feedback

(percentage points; on top of adverse scenarios, third year)



Sources: FINMA, SNB, banks' financial reports, and IMF staff models and calculations.

BANK LIQUIDITY RISK ANALYSIS

A. Liquidity Stress Test Methodology

46. A cash flow-based liquidity stress-test model was employed. It operates on banks' individual, detailed maturity profiles for different types of liabilities, coupled with assumptions for runoff rates for the maturing portion of these liabilities, and their assumed contractual term structure for the portion that rolls over. The counterbalancing capacity includes all financial assets that are not loans and unencumbered, including cash and reserves at banks' central bank account, deposits in other banks (i.e., interbank claims), reverse repo lending, and bond and equity holdings. The latter are optionally revalued in line with the market risk shocks as used in the solvency stress test. The model also accounts for a reverse link back to solvency, for HTM bond sales (sorted last in a sales hierarchy) to cause losses when they need to be sold to honor liquidity outflows.

47. The model entailed severe assumptions for deposit outflows, committed credit line drawdowns, and lower asset valuations. The run-off rates, informing the liability run-off driven outflow of liquid assets, was informed by regulatory LCR stress assumptions as well as the recent run-off dynamics of CS. The cumulative runoff rates for the portion of liabilities that mature within 30 days were assumed to be as follows: 10 percent for household sight deposits, 30 percent for household term deposits, between 30 and 40 percent for deposits from NFCs, banks, NBFIs, and bonds, and 15-25 percent for secured funding. Banks' open committed credit lines were assumed to be drawn by 20 percent within the first four weeks. Beyond a "reference liquidity stress scenario," an additional simulation included as input the valuation changes for bonds and equity exposures from the market risk module of the solvency stress test. These involved, respectively, the demand and supply shock scenarios with their different market stresses (Appendix C). The model also captured the collateral add-back mechanism related to secured funding, while accounting for the drop in value of that collateral in line with the market risk model, as hinted to above.

B. Liquidity Stress Test Results

48. The liquidity stress test results suggest an overall adequate level of resilience at the banking system level. While all banks satisfy LCR requirements, some regional and smaller banks, as well as some asset and wealth managers appear somewhat vulnerable, already based on data (Figure 20), before considering the liquidity simulation model. Based on the model simulations, of the 92 banks, 10 were estimated to experience a liquidity shortfall before 30 days, all of which are regional and other banks. The liquidity shortfall of the failing banks accumulates to 0.15 percent of the initial liquid assets of all 92 banks (Figure 21).

49. Up to a six-month horizon, under the most severe scenarios with maximal stress on the valuations of bonds and equity holdings, a larger number of banks would fail. In this case, up to 19 banks were identified to face a liquidity shortfall, most of which are small regional banks. Such more severe stress and resulting liquidity shortfalls was primarily meant to rank the banks in relative terms regarding their risk profiles, not necessarily for deriving "absolute" stress resilience, due to the particularly pronounced, assumed level of stress.

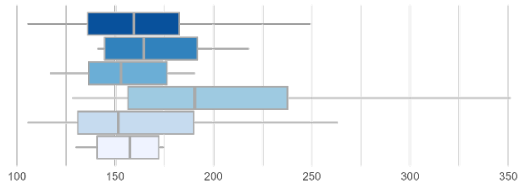
50. Feedback from HTM bond sales to bank solvency was found to be limited. It was relevant in principle under the supply shock extension of the liquidity stress test, where HTM bonds lose value at the outset, amid rising interest rates in the scenario.[17] This variant of the liquidity stress simulation showed that at the 6-month horizon, 10 banks would face feedback of less negative than -0.5 p.p. shift for their solvency ratios; and five more negative than -1.5 p.p.; including banks from the regional bank cluster and the asset/wealth managers. Numerous of these banks avert an outright liquidity shortfall by selling the bonds, in the simulations. Alternatively, one can interpret this mechanic not as selling the HTM bonds but using them for repo borrowing from the central bank.

Figure 20. Switzerland: Bank Liquidity Risk—Selected Metrics

Cantonal, regional, and other banks have lower LCRs than the other bank clusters.

A. LCR

(percent, by bank cluster, see legend at bottom; end-2024)

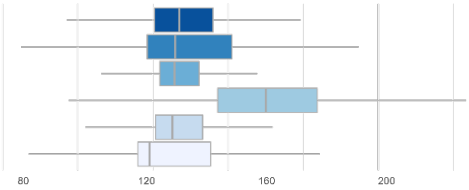


The cumulative funding gaps relative to banks' initial liquid assets is most negative for regional banks.

NSFRs rest at comfortable levels for the median of the banks in all clusters, while they are higher for asset/wealth managers.

B. NSFR

(percent, by bank cluster, see legend at bottom; end-2024)

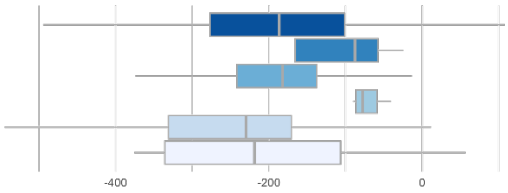


Unencumbered liquid assets (reserves, bonds) as a percent of total liabilities are lowest for regional and other banks.

[17] Initial valuation gaps between book and market values for HTM bonds—pre-stress, at "T0"—were found to be small for virtually all banks.

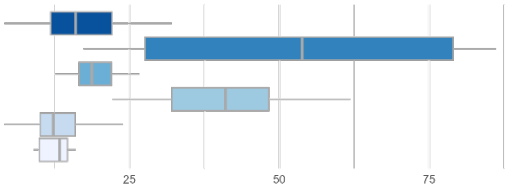
Figure 20. Switzerland: Bank Liquidity Risk—Selected Metrics (Concluded)

C. Cumulative Funding Gap after 1 month (from LMT)
(percent, by bank cluster, see legend at bottom; end-2024)



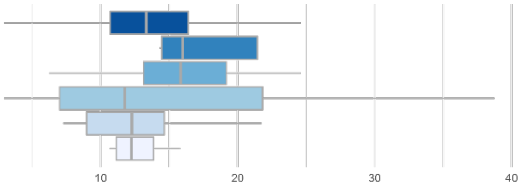
Cash and reserves relative to total liabilities (TL) are lower (at the median) for asset managers, regional, and other banks.

D. Unencumbered Assets over Total Liabilities
(percent, by bank cluster, see legend at bottom; end-2024)



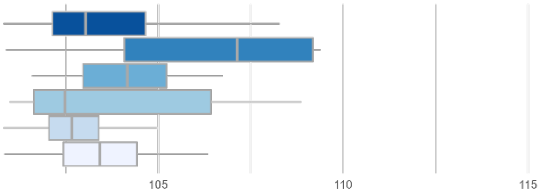
Off-balance sheet commitments, e.g., through credit lines for bank customers and guarantees, are highest for SIBs.

E. Cash and Reserves over Total Liabilities
(percent, by bank cluster, see legend at bottom; end-2024)

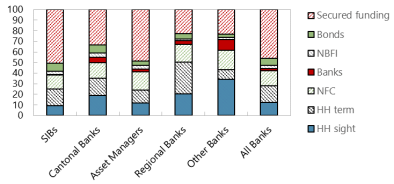


All bank clusters have sizeable shares of secured bond funding (esp. via covered bonds). Household term deposit liabilities are comparably most sizeable for regional banks.

F. Off+On Balance Sheet Assets over On-Balance Sheet
(percent, by bank cluster, see legend at bottom; end-2024)



[G] Banks' Liability Structure (excl. equity)
(share in total, end-2024)

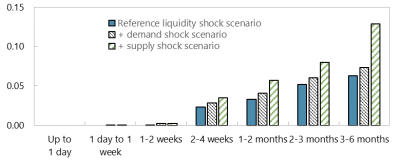


Sources: FINMA, SNB, and IMF staff calculations.
Note: The horizontally arranged box plots follow the sequence of bank clusters as shown in the legend at the bottom right of this figure panel. The vertical lines in the middle of the boxes are medians. The edges of the boxes mark the 25th and 75th percentiles of the distributions of the underlying banks. The whiskers on the left and right extend to 1.5 times the interquartile range.
"Secured funding" in panel [G] comprises covered bonds, asset-backed securities, secured borrowing from the SNB, and currency swaps The underlying data are consistent with those in Figure 7C, where the liability segments are defined somewhat differently.

Figure 21. Switzerland: Bank Liquidity Stress Test Results

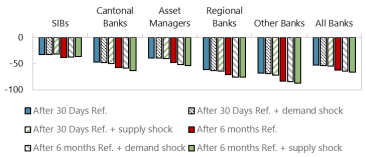
The liquidity shortfall of the failing among the 92 banks accumulates to 0.15 percent of initial liquid assets of all banks.

Cumulative Liquidity Shortfall
(in percent of initial unencumbered liquid assets)



Unencumbered liquid asset stocks drop most visibly in the regional (and other) bank cluster.

Drop in Unencumbered Liquid Asset Stocks - Median Within Clusters
(percent)



Sources: FINMA, SNB, and IMF staff calculations.

INSURANCE SECTOR SOLVENCY AND LIQUIDITY RISK ANALYSIS

A. Insurance Sector Characteristics and Scope of the Solvency Stress Test

51. The insurance sector stress test was run on a consolidated group basis, including the activities of all large Swiss insurance groups worldwide. The resilience of the insurance sector was assessed through bottom-up (BU) and top-down (TD) stress tests, using end-2024 balance sheets as a baseline. Six Swiss insurance groups were included in the stress test, accounting for about two thirds of the Swiss life and non-life insurance market and 70 percent of the reinsurance sector in Switzerland. One group is active rather solely in the domestic market, while the other five are designated as Internationally Active Insurance Groups (IAIGs), with between around 40 and 90 percent of their premia written outside their home market. For two groups, the reporting currency is USD.

52. The insurance groups' investments are characterized by a high exposure to fixed income assets and a significant share of direct and indirect real estate investments. The insurers' investments account for 60 percent of their balance sheet and unit linked business-related assets add another 25 percent. More than half of the investments relate to government and corporate bonds. Direct property investments plus mortgages and real estate funds represent more than a fifth of insurers' own investments.

53. The insurers' investments are generally of high quality, but illiquid assets have increased over the last years. More than 90 percent of bonds are of investment grade, more than half thereof of AA rating or higher, with the credit quality of financials (half of all corporate bonds, a third of which are covered bonds) being higher than those of non-financials. Cash levels (above two percent of total assets) are higher than those of European peers but so is the Swiss groups' exposure to illiquid assets. Both property-related and alternative investments have been growing and constitute a significant share of the total. The mortgage exposure is high in a European context but low LTV (around 60 percent LTV at origination on average) and "DSTI-type" metrics[18] (below 40 percent for those mortgages where data is available) mitigate impact and probability of materializing credit risk.

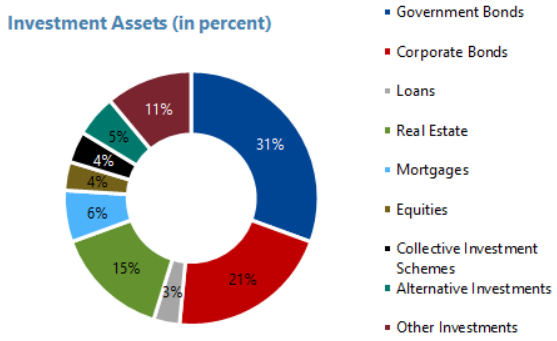
54. Most insurance groups' financial investments are outside their home country, closely matching their corresponding liabilities. While real estate is mainly held domestically, only a small share of equities (19 percent) and bonds (15 percent) is held in local currency. This reflects the large size of insurance business outside Switzerland. The currency exposures on the asset side are largely

[18] FINMA uses an affordability ("DSTI") indicator, which is calculated as (interest expense + amortization + maintenance) / income for owner-occupied properties and (interest expense + amortization + maintenance) / sustainable rental income for investment properties. Please note LTV and "DSTI" figures above refer to the whole market and not just the stress test sample.

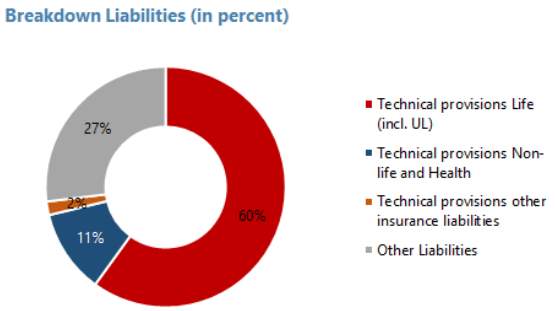
aligned with those on the liability side. The remaining foreign exchange risk is partially hedged via currency derivatives.

Figure 22. Switzerland: Insurance Sector—Balance Sheet Composition

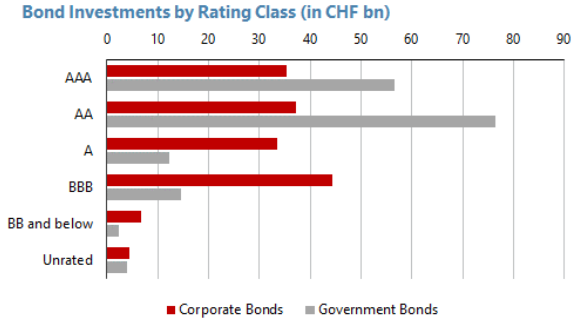
Fixed income assets, including government bonds, corporate bonds and real estate dominate the insurers' investments.



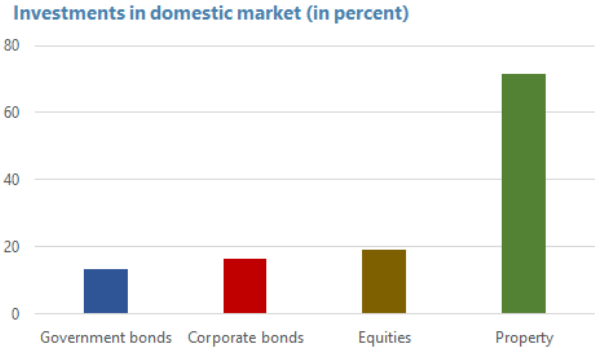
60 percent of the insurers' liabilities relate to technical provisions of their life business.



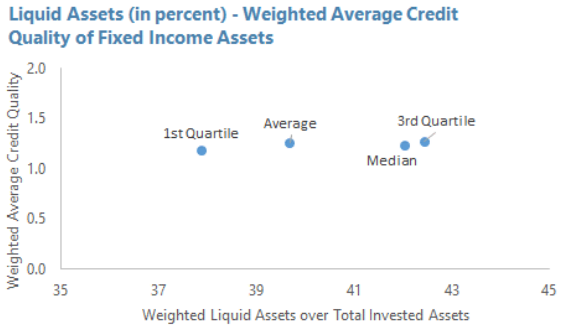
Bond investments are generally of high quality with around 56 percent of AA rating or higher.



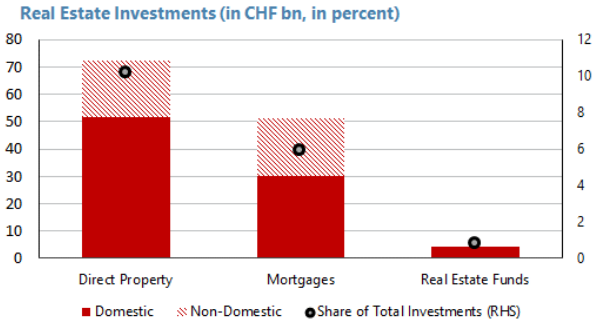
The home bias in financial securities is small compared to peer countries, which reflects the internationality of Swiss insurance groups.



Overall, investments are of fair quality and generally liquid.



Swiss properties constitute a significant share of overall investments.



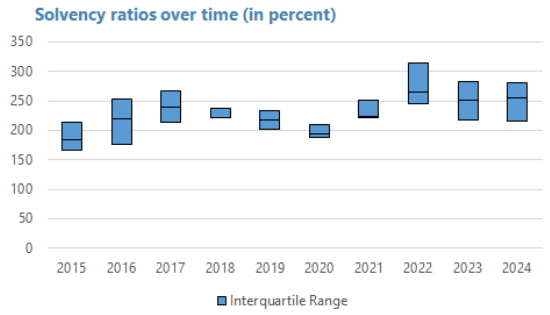
Sources: IMF staff calculations based on company submissions

Notes: Stress test participants only. The breakdown of assets excludes unit- and index-linked insurance. Alternative assets include hedge funds, private equity and commodities. Haircuts are applied to the liquid assets largely in line with the banking LCR. Credit quality 0 is equivalent to a AAA rating, credit quality 1 is equivalent to a AA rating.

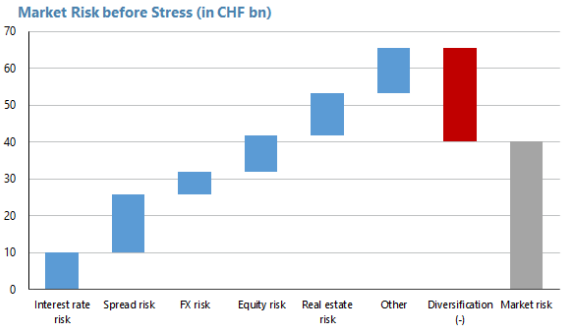
55. The insurance groups have healthy solvency ratios. The Swiss Solvency Test does not generally allow for a Solvency II-type volatility dampener or other measures to reduce the impact of strong interest rate changes. This makes solvency ratios more volatile but also more transparent as the market-consistent valuation feeds through to the assets and liabilities. Nevertheless, the insurers managed to keep solvency ratios significantly above the regulatory minimum. The higher interest rates over the last years are reflected in the higher ratios. A negative duration gap of two years means that liability values have been falling by more than asset values. Overall, assets and liabilities are well matched, explaining the comparatively low net contribution of interest rate risk as well as currency risk to the capital requirements.

Figure 23. Switzerland: Insurance Sector—Own Funds and Solvency Risks

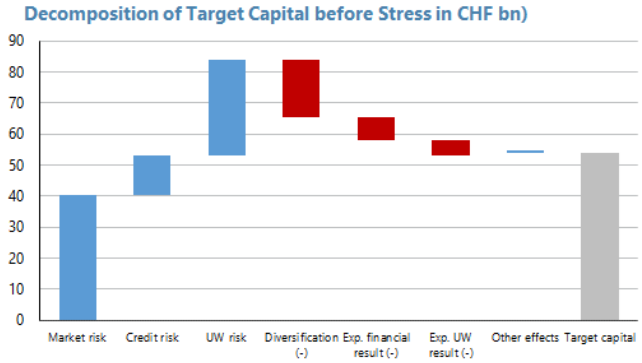
Solvency ratios have been volatile but healthy over time.



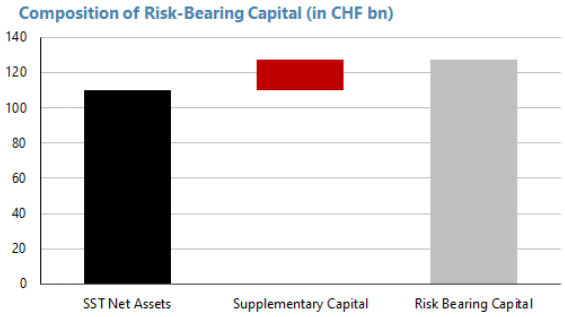
Although assets and liabilities are well matched, the market risk capital requirements reflect the high exposure to fixed income investments (bonds, mortgages and loans)



Market and underwriting risks are the main drivers of insurers' target capital



Core capital dominates insurers' own funds.



Sources: IMF staff calculations based on company submissions
Notes: The market risk decomposition does not include all participants.

B. Scenarios and Solvency Stress Test Methodology

56. The macro-financial scenarios specified above for the banking sector stress test also served as the basis for the insurance stress test, with some adjustments. These adjustments intend to make the scenario more directly applicable to an insurer's balance sheet. While the scenario includes a three-year ahead projection of macro-financial variables, for the insurance stress

test all shocks were assumed to occur at the beginning of the first year (instantaneous shock approach). Market shocks have therefore been front-loaded so that the maximum drawdown during the project horizon of the scenario is already realized immediately after the reference date (31 December 2024). By complementing the stress test with an assessment including reactive management actions, some features of a multi-period perspective have been re-introduced.

57. To cover the most relevant risk factors for an insurer's balance sheet, the market risk stresses have been defined more granularly. The scenario includes shocks to the risk-free interest rate, equity, and real estate prices, default rates of mortgage loans, credit spreads of corporate and sovereign bonds, as well as shocks to the exchange rate. Table C4 in Appendix C summarizes the adverse scenario features for insurance firms.

58. The Swiss Solvency Test (SST) serves as the basis for the insurance stress test. The main output of the stress test calculations is the effect on risk-bearing capital and subsequently the coverage of the target capital. For simplicity, these calculations only account for the impact of market stresses on the exposures, i.e., without recalculation of the risk models after shock. For the bottom-up stress test, insurers were allowed to use their FINMA-approved (full) internal models. This applied to two groups within the sample.

59. Participating insurers were requested to provide their results without and with reactive management actions. Management actions were allowed to be applied only as far as they relate to non-discretionary arrangements already in place at the reference date, i.e., as of end-December 2024. However, in times of financial stress, insurers have several options to restore their capital adequacy and/or profitability, including changes in underwriting standards, in the reinsurance program or by withholding profits. In addition, they may improve their solvency position by de-risking the balance sheet.[19] This is not modelled in the top-down stress test but an integral part of the BU exercise. By accounting for behavioral adjustments through the application of reactive management actions, features of a multi-period perspective are taken on board. Insurers were also asked to provide additional information on embedded and reactive management actions, including their expected impact.

60. Three-year projections of business development under the baseline and the adverse scenario provide information on the recovery. Key figures requested include projected premia, claims, lapse rates, investment returns, net earnings, insurance liabilities, risk-bearing capital, and the target capital. For the projections, it was assumed that the market value of investments stayed constant after the occurrence of macro-financial shocks at the reference date. This is due to the assumption of an instantaneous shock. Therefore, any recovery in profitability, and ultimately solvency, would be driven solely by the underwriting business and recurring investment income from interest, dividends, and rents.

[19] For instance, by changing their asset allocation towards less risky assets and applying hedging strategies, they may address the impact of falling bond values and increasing spreads. Dividend retentions and intra-group management actions are additional ways to bolster their risk-bearing capital and thus improve solvency ratios.

61. To benchmark the results of the BU stress test, a simplified top-down stress test was performed. The TD analysis is based on granular data received from the insurers. It includes a detailed breakdown of investment assets, government and corporate bond holdings in particular, as well as maturities and coupon rates of fixed income investments. In addition, a detailed maturity breakdown on asset and liability cash flow projections was requested. The focus of the TD analysis is on the balance sheet impact of financial shocks. The TD exercise does not include a separate calculation of SST coverage ratios. No look through to unit-linked business was applied.

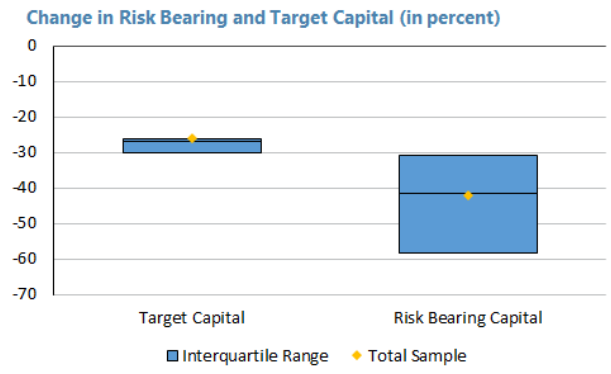
62. For the TD stress test, the shocks specified in the scenario were applied to the investment assets and insurance liabilities. Haircuts in line with scenarios were applied to the market values of assets, and a revaluation of fixed income assets was undertaken with the stressed term structure by currency. Similarly, technical provisions were re-valued with the stressed term structures. No look through was applied.

C. Solvency Stress Test Results

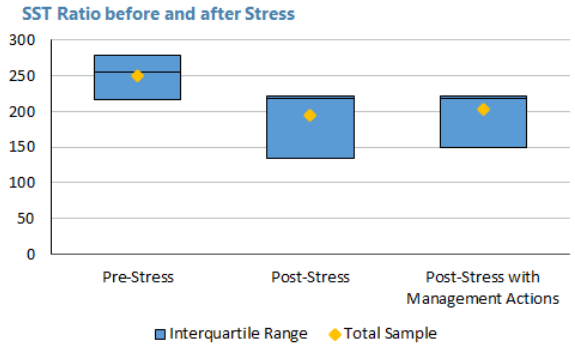
63. The industry can withstand severe price shocks, despite vulnerabilities on the asset side. According to the BU calculations, the median SST ratio drops from 255 percent before stress to 219 percent after stress. No insurer fell below the regulatory minimum. Only two insurers applied (a restricted number of) reactive management actions, which brought the SST ratio closer to the internal risk appetite limit. Measures were both targeted at reducing the target capital by lowering market risk exposures (for instance, by reducing equity exposure and investing in government debt to further reduce the duration gap) and bolstering risk bearing capital, for instance, via subordinated debt issuances. Applying those limited post- stress management actions would lead to 15 and 20 percentage point increases in SST ratios for those companies.

Figure 24. Switzerland: Insurance Sector—SST Ratios After Stress

The financial shocks have a significant impact on post stress capital requirements and insurers' own funds



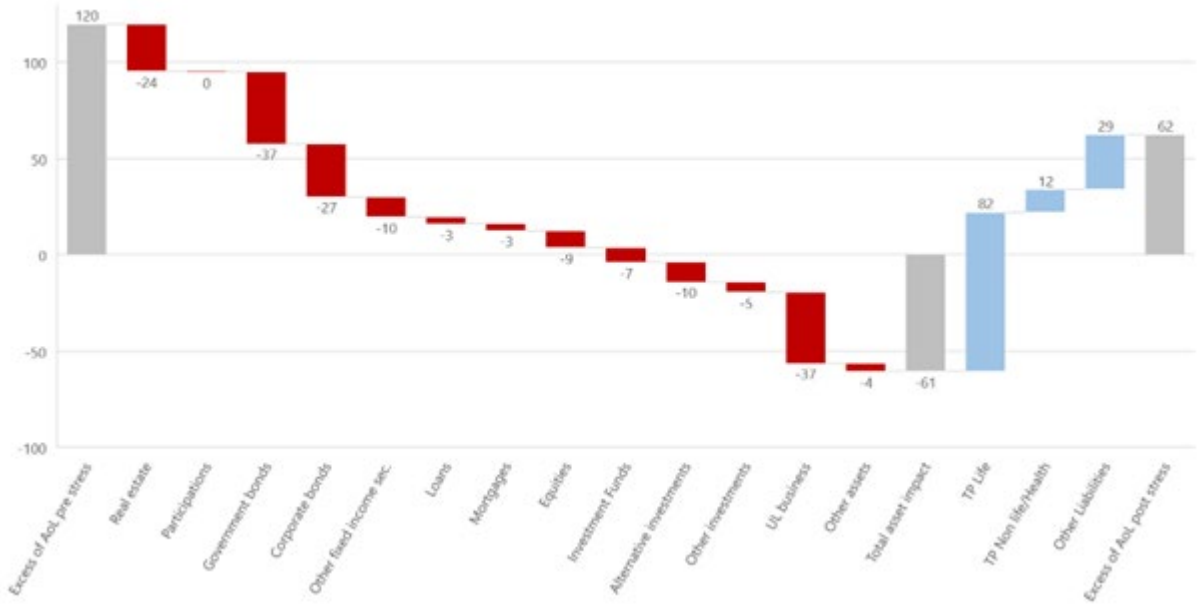
Together, this leads to a 50 percentage point fall of the weighted average SST ratio (total sample).



64. Valuation losses from severe market stresses lead to a significant fall in insurers' own funds. For the whole sample, the SST ratio fell by more than 40 percentage points (a size-weighted aggregate), from a baseline of 236 percent. The main driver of this fall was the reduction in risk-bearing capital after stress. The strong fall in assets was only partially compensated for by a corresponding reduction of technical provisions, shrinking of the balance sheet by CHF 180 billion and leading to an almost halving of risk-bearing capital. Due to lower asset and liability exposures post- stress, the new target capital falls by 32 percent, offsetting some of the impact of the losses of risk bearing capital on the SST ratio. The average assets over liabilities ratio fell from 117 percent to 110 percent or a corresponding loss in equity (excess of assets over liabilities) of nearly CHF 60 billion.

Figure 25. Switzerland: Insurers—Decomposition of Assets Over Liabilities

The insurers' excess of assets over liabilities is significantly affected by a drop in asset values, which is only partially compensated by a fall in technical provisions and other liabilities.

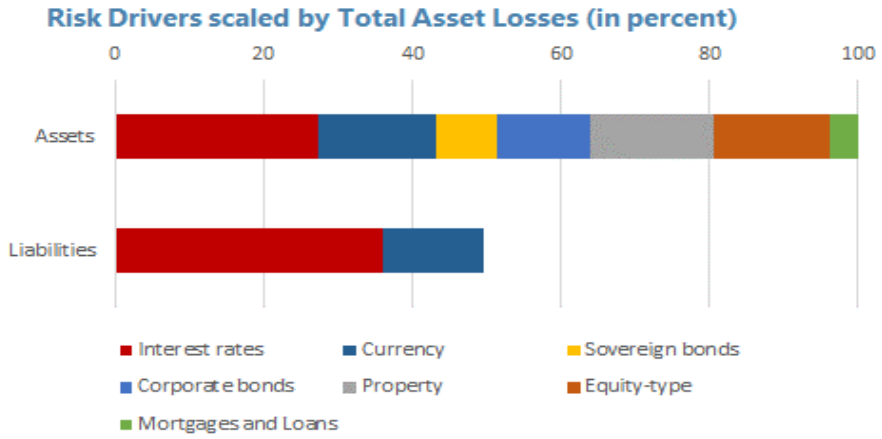


Source: IMF calculation based on company submissions

65. Asset valuation losses due to significant interest rate hikes are compensated for by corresponding falls in technical provisions. Swiss insurers have an average negative duration gap of around two years. The net valuation effect of the rise in interest rates is positive. It also strengthens solvency, as the valuation effect bolsters the risk bearing capital, while the target capital also tends to fall due to capital requirements being applied to a lower base. Higher rates may, however, negatively impact insurers' income statement and liquidity position. The insurers' projections do not provide a uniform message, but it is conceivable that such an environment may lead to higher lapses at least in the short term, similar to the period of the pandemic. Some insurers may also face liquidity losses from margin calls due to their higher short positions in interest rate derivatives.

Figure 26. Switzerland: Insurers—Risk Drivers in the Adverse Scenario

The largest net impact on excess of assets over liabilities stems from fixed income related spread risk, followed by property and equity risk.



Source: IMF calculation based on company submissions
Note: The graphs are based on the TD analysis. No look through to all assets was applied, non-investment assets are assumed to remain unchanged, focus on technical provisions on the liability side

66. A scenario with a fall in Swiss interest rates, all other shocks unchanged, would only have a moderate impact due to short asset and liability durations and strong ALM positions.[20] In such an environment, liabilities would increase slightly more than assets, leading to a net negative impact on valuation. Close matching of assets and liabilities and other hedging strategies, however, mitigate the impact. A cash flow analysis of net liabilities and net assets showed that after five years the difference converges quickly to zero, highlighting the good matching. Another important factor is that guaranteed interest rates are lower than they were before the start of the prolonged low-interest rate environment. Therefore, another period of low interest rates will be less impactful.

67. The strengthening of the CHF against a basket of currencies has a small net negative impact, particularly for institutions with CHF as reporting currency. In aggregate, foreign currency asset exposures are in most cases largely aligned with the insurance business in the respective countries. The currency risk results from the difference between the two positions, mitigated by insurers' hedging against a strengthening of the home currency.

68. Spread risk and property risk, followed by equity risk have the largest net impact on excess of assets over liabilities. Given the size of the exposure and the lack of offsets on the liability side, spread, property and equity shocks have the strongest impact on the balance sheet. The scenario assumptions are severe, but these risk drivers will also be dominant in more benign environments.[21] It should be noted that a real estate shock can propagate through several asset types, thus increasing the sector's overall exposure and the actual contribution to the stress on the

[20] Two insurers report in USD and most groups have a significant share of their business outside Switzerland.

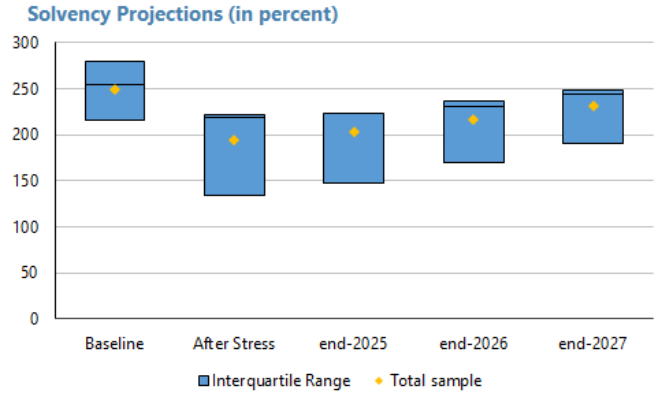
[21] For reference, compare against graph on decomposition of market risk factors in the baseline.

balance sheet. Direct real estate represents around 15 percent of total investments, mortgages another six percent, real estate funds around one percent (three percent of their exposure to collective investment schemes), and insurers may also hold equities and bonds of real estate corporations.

69. The insurers' own three-year projections after the event indicate an improvement of the solvency position but not a full recovery. Solid underwriting performance and investment returns improve the insurers' profitability and technical results. The solvency position cannot be fully restored within this three-year time frame. The scenario led to an average fall in the SST ratio of around 60 percent and is expected to recover around 30 percentage points by end 2027.

Figure 27. Switzerland: Insurance Sector—Solvency Projections

Insurers' solvency positions improve over a three-year horizon but no full recovery.



Source: IMF staff calculation based on company submissions

D. Liquidity Risks

70. Even if less prevalent than in other sectors, insurers are exposed to liquidity risk. Margin calls on derivatives exposure and policyholder surrenders are generally the most prominent drivers for insurers' liquidity strains.[22] Due to their international exposure, Swiss insurers use foreign exchange derivatives to hedge against adverse currency corrections. They also hold interest rate derivatives to address duration mismatches of assets and liabilities, even though to a lesser degree. Swiss insurers also have a significant share of lapsable insurance policies, even though surrender values may be at a significant discount, reducing the propensity to withdraw.

71. Apart from any specific regulatory requirements, there are important risk mitigating factors that can reduce Swiss insurers' liquidity risk. One aspect is the access to a liquid repo market and SNB's standing facilities (intra-day liquidity and liquidity-shortage financing facility) for larger institutions. Larger insurance companies take part in a bilateral repo market operated by SIX Swiss exchange, which is a platform on which also the Swiss central bank is active and can intervene

[22] For non-life insurers, liquidity shortages may also arise from large man-made or natural catastrophes and consequent claims that may have to be paid within a short period of time.

directly.[23] This allows smoothening (short-term) liquidity shortages. Smaller insurers may have less incentive to participate on this platform given their lower FX-exposure, and they may also be unable to fulfil the minimum trading requirements.

72. Contractual and legal restrictions mitigate the liquidity risk from policyholder withdrawals. If a policyholder decides to surrender a contract, the surrender value has to be paid within a period of three months, unless extended by FINMA in limited circumstances. The insurer is allowed to make the following two adjustments to the surrender value: 1) deduction for interest rate risk, covering for the potential losses incurred of having to sell interest-bearing instruments within the portfolio. This discourages surrender, especially in times of increasing interest rates but also addresses the liquidity risk that arises from lower asset values at the point of sale. 2) Partial claw back of costs incurred in connection with the sales of an insurance contract. Such costs (up to five percent of the premium sum) may be amortized over the duration of the contract, with the policyholder required to pay the remaining amount at the point of surrender. Together, the deductions are not allowed to exceed one third of the surrender value. Severe restrictions to surrender apply when premia can be deducted from the income tax basis. Furthermore, insurance contracts that are paid out instead of being annuitized also face non-negligible tax disincentives as the regular annuity payments are taxed at the corresponding post-retirement income tax rate.

73. Using the scenario narrative of the solvency stress test as a reference, the liquidity analysis focused on two aspects: liquidity risk from mass lapses and variation margin calls. No separate liquidity stress test was conducted but the shock scenario of the solvency stress test, which was run on the assumption of an instantaneous shock, gives some useful indication of the sector's exposure to liquidity shocks stemming from market drivers.

74. From a liquidity perspective, the scenario is net positive for the insurers' derivative books. The higher margin calls due to increasing interest rates are offset by the additional liquidity stemming from their currency derivatives position, hedging against an increase in CHF. Low asset encumbrance levels, unpledged cash to total assets ratios of more than two percent on average and access to the repo market serve as a further risk mitigant.

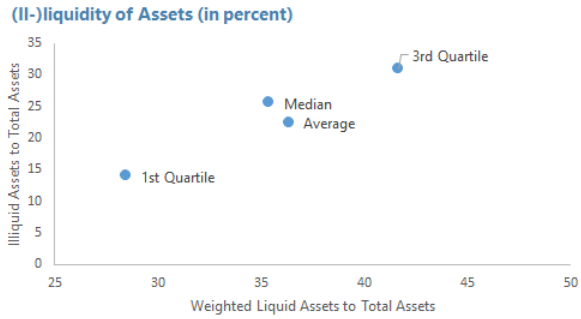
75. High shares of high-quality liquid assets serve as a buffer against unforeseen mass lapse events. The best estimate value in aggregate exceeds total surrender values by a considerable margin, suggesting that surrenders would have a net positive solvency impact. The liquidity impact of a mass lapse can be substantial but high cash levels combined with a generally large share of high-quality, liquid assets mitigate the impact.[24] At the group level,[25] insurers have sufficient liquid funds to withstand even significant redemptions, particularly in light of deferred payouts. They would also be able to service a complete wipe-out. The non-immediate payout of the surrender values means that a fair share of the surrenders could be serviced through regular cash flows from investment income and premia. On average, around nine percent of their fixed income assets mature every year. Assuming a quarter of these assets mature within the first trimester and an

[23] One requirement to access the repo market is holding a sight deposit account at the SNB.
[24] Note: Lapses and surrenders are assessed only from the perspective of the life business.
[25] Note: The analysis is at the group level and assumes fully fungible capital. It does not draw any conclusions on any liquidity strains at the subsidiary level.

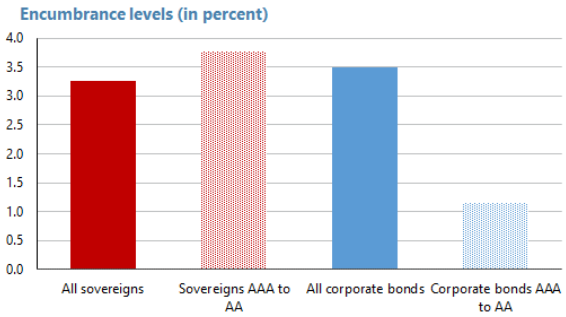
average annual coupon of around two percent, quarterly cash inflows would represent around ten percent of total surrender values.

Figure 28. Switzerland: Insurance Sector—Liquidity Position Swiss Insurance Groups

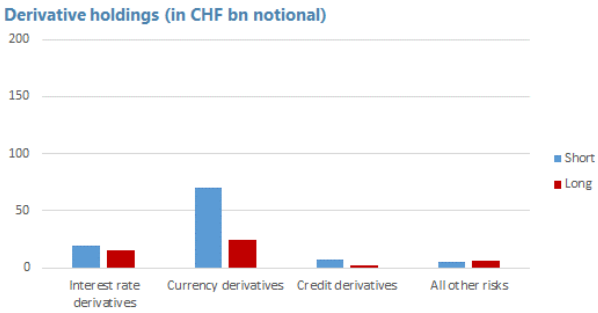
Liquid assets represent a fair share of overall assets.



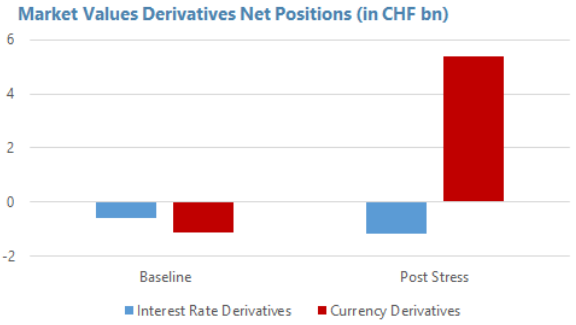
Asset encumbrance levels are generally low.



Insurers use derivatives mainly for currency hedging.



Currency stresses lead to significant change in market values of derivatives.



Source: IMF staff calculation based on company submissions
Note: Haircuts are applied to the liquid assets largely in line with the banking LCR. Only unpledged assets are considered. Notional amounts in the lower left hand side graph are provided in absolute numbers

E. Cyber Risk

76. The cyber sensitivity analysis assessed the resilience against underwriting risks stemming from two cyber scenarios. The exercise is run separate from the macro-financial scenario and is based on end-2023 data. The assessment covers insurance risks from affirmative and silent cyber underwriting. Silent cyber refers to the unknown or unquantified exposures stemming from cyber perils that may be triggered within traditional (non-life) insurance policies. Direct losses incurred by the insurers (i.e., cyber operational risk) are not covered in this exercise.

77. Two scenarios were tested, one including the outage of a cloud service provider, the other simulating a Petya/WannaCry-type ransomware attack[26] For both scenarios, no war exclusion applies, as the tacit support by a nation-state cannot be proven.

[26] These events have been informed by the Lloyd's realistic disaster scenarios as well as cyber stress tests executed in other European countries.

- **Scenario 1**: A one-week outage of the largest cloud service provider (CSP) following a cyber-attack
- **Scenario 2**: A state-based actor exploits a vulnerability in the update mechanism of a commonly used software to deliver its malicious software payload, using trusted applications as cover.

78. While cyber insurance was negligible ten years ago, it has grown substantially since 2020 but remains a small share of total business. The total premium volume in 2020 was around CHF 450 million, growing by more than 130 percent over the following three years. Cyber related premia, however, remain less than one percent of total business.

79. Gross cyber claims can significantly exceed premium income but the direct impact on SST ratio remains small. The ransomware attack is somewhat more significant than the outage of a cloud service provider. While the average fall in the SST ratio in the former case is five percentage points, it is three percentage points in the latter. All losses are related to their cyber underwriting business. Insurers assume that they do not face silent cyber losses. Currently, cyber risk only leads to a small solvency impact. The significant cyber-specific loss ratios, however, indicate that potential losses could become higher if cyber underwriting continues to grow following the trajectory over the last years, even though the explicit exclusion of silent cyber exposure serves as an important risk mitigant.

PENSION FUND SECTOR

A. Motivation

80. The systemic risk associated with pension funds is generally assumed to be low, but the sector's sheer size and its footprint on the capital market justifies additional scrutiny. Research indicates that pension funds tend to contribute to financial stability, often acting as counter-cyclical investors and thus dampening the overall risk in a period of crisis. However, pension fund sectors and corresponding regulation vary significantly across jurisdictions and so does their systemic relevance.

81. The Swiss pension fund system is assessed against several factors that can play a role as potential contributors to systemic risk. While not exhaustive, the following list of factors may provide first high-level insights into the potential systemic relevance of a pension sector:

- Concentration and size of the sector in absolute terms and relative to the overall economy;
- Size of the pension funds relative to their sponsoring companies;
- Type of pension plan (defined-benefits versus defined-contributions);
- Home bias of investments;
- Herding behavior in asset allocation;
- Derivatives exposure and leverage;

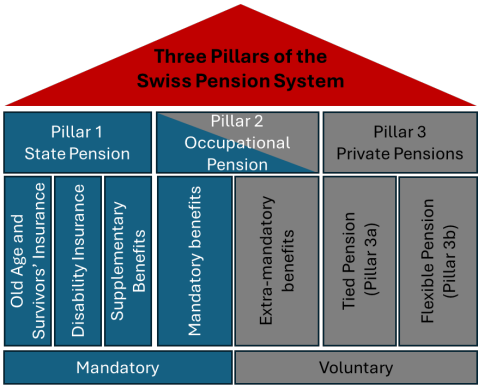
- Access to funds by individuals;
- Flexibility and breadth of available restoration measures.

82. Although not all relevant information was available to the FSAP team, many factors suggest that the systemic footprint is dampened by the current structure of the Swiss pension sector. The sector is large but consists of many, often very small, institutions. With the exception of real estate and mortgages, which are mostly domestic, the asset allocation is geographically diverse. Individuals have only restricted early access to their funds (for purchase of own property and taking up self-employment), thus limiting potential liquidity concerns. The pension system has some elements of a defined benefits scheme but the risk of forced sell-offs of investments in case of underfunding is limited by broad and flexible restoration measures, which can also be stretched over several years. The rules for derivative instruments are comparatively strict regarding their use and accounting requirements and explicitly forbid their use for the buildup of leverage.[27]

83. Nevertheless, the potential impact on capital markets should not be underestimated. The market is consolidating and increasingly concentrated, with several small players leaving the market while others are growing. Some of those players face tight competition. Furthermore, they have a sizable investment in domestic real estate (CHF 217bn compared to CHF 67bn for the insurance sector). Foreign investments reduce their home bias but expose them to market developments in other countries.

84. Data availability remains a considerable constraint. It is advisable to assess in more detail funds' investment behavior across the cycle in conjunction with the development of the funding position, using a consistent basis for the calculation of pension liabilities.

B. The Swiss Pension Fund Sector at a Glance



85. The Swiss pension system builds on three interdependent pillars. Pillar 1, covering old age and survivors' insurance (OASI), disability insurance and supplementary, i.e. loss of earnings, benefits[28], is run as a pay-as-you-go (PAYG) system. It is mainly financed through contributions by employees and employers (72 percent). The remainder is covered by the (federal) state, with VAT and casino taxation being important sources. Investment returns play a negligible role due to its PAYG nature. All employees with a salary subject to OASI contributions are also subject to Pillar 2 pensions. According to the Federal Social Insurance Office (FSIO), together, these two insurance systems should ensure that retired people to a large extent maintain their former standard of living. I.e., they should jointly provide approximately 60 percent of the last salary. Pillar 2 occupational pensions are financed by mandatory contributions from employers and employees. The law on occupational benefits (LOB) differentiates between the mandatory and extra-mandatory portions of the annual salary. The LOB only regulates the former.

[27] Cf. Art 56a BVV2 related to Art. 71 (1) BVG)
[28] Tax-funded supplementary benefits secure livelihood if other state security benefits or own income are not sufficient.

Pillar 3 refers to voluntary private pension provisions, consisting of tied pensions (Pillar 3a) and flexible pensions (Pillar 3b). The main difference lies in the tax treatment. In the former case, payments can be deducted from taxable income (The annual maximum for employed persons in 2025 is CHF 7258) but similar strict withdrawal restrictions apply as for Pillar 2 pensions. Pillar 3b payments are not tax-deductible but are more flexible in their withdrawal.

86. The second Pillar pension sector, one of the largest in the world has reached a size of CHF 1.2 trillion or 152 percent of GDP by end-2023. For comparison, the Swiss banking and insurance sectors have a size of about 400 and 60 percent of GDP, respectively. Since the FSAP in 2019, total asset size has grown by 12 percent, mostly due to a 10 percent higher number of insurants. At the same time, the sector consolidated further. The number of pension funds fell by 101 to 1,355 (heterogeneous) entities, 91 of which relate to public-sector employers. Ten years earlier, there were still 1,845 pension funds.

87. The consolidation predominantly affects small (single employer) pension funds, leading to a smaller number of institutions dominating the market. The number of single-employer pension funds, 10 years ago by far the largest category, has fallen by more than 40 percent. Pension funds of other administrative forms also consolidated but to a far lesser extent. Over the same period, the number of active members has grown by three quarters of a million to 4.8 million. The consolidation of the sector has led to an increasing concentration of the sector. The largest 14 percent of the sector (institutions with a total asset size of more than CHF one billion) represent 82 percent of active members and total pension assets. Pension funds with a balance sheet size of less than CHF 100 million still cover more than 44 percent of all institutions but less than two percent of all active members and total pension assets.

88. Collective and joint foundations are increasingly replacing single-employer pension funds. Their number has largely remained stable while all other categories have fallen significantly. They represent 17 percent of all institutions but cover more than half of all assets and three quarters of active members. Three fifths of retirees receive their pension from a collective or joint foundation, indicating a healthy ratio of active to retired members.

89. Semi-autonomous solutions are gaining in importance, as smaller pension funds increasingly opt for partial insurance covering the investment risk. The low-interest rate environment has made full insurance solutions less attractive for insurance companies, leading to a significant fall in supply and a corresponding reduction in the number of fully insured pension funds and covered liabilities. Overall, the dominant solution remains the autonomous pension fund, which covers both investment and biometric risks. They represent 35 percent of all pension funds and around 70 percent of respective liabilities.[29]

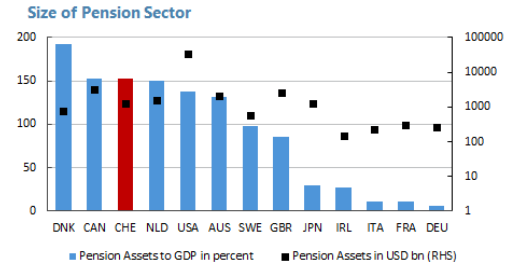
90. Defined contribution (DC) regimes dominate the Swiss market. The share of DC pension schemes has gradually increased and now represents almost 90 percent of all pension liabilities. Defined benefits (DB) schemes can mainly be found in pension funds with a state guarantee, where they represent more than 40 percent of pension liabilities but only seven institutions.

[29] A small share thereof uses a stop-loss or excess of loss insurance.

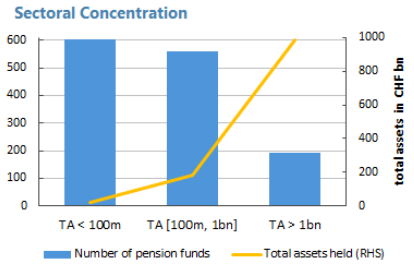
91. Swiss DC schemes are hybrid regimes, sharing some features of DB schemes.[30] Albeit in essence DC schemes, Swiss pensions may be better described as cash balance plans: While insured members bear the financial market risk, the exposure is floored through a minimum guaranteed interest rate. Furthermore, the conversion rate guarantees a fixed percentage of annual pension payout, which cannot be reduced after the start of retirement.

Figure 29. Switzerland: Occupational Pension Fund Market

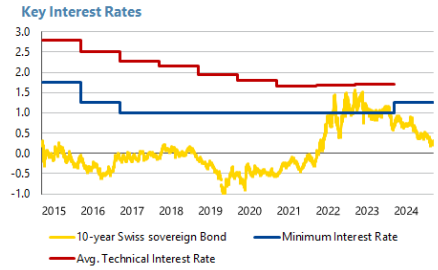
The Swiss pensions sector is one of the largest in the world….



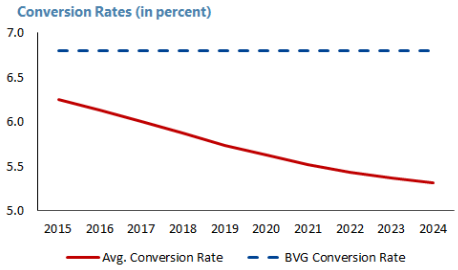
…. with many small institutions but a concentrated market overall in terms of total assets.



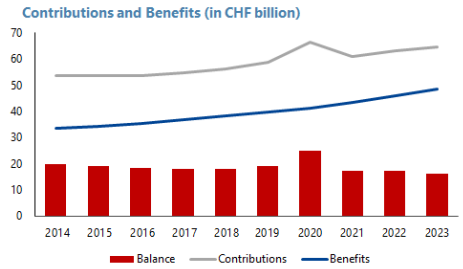
An environment of low investment returns is reflected in falling current and future return expectations….



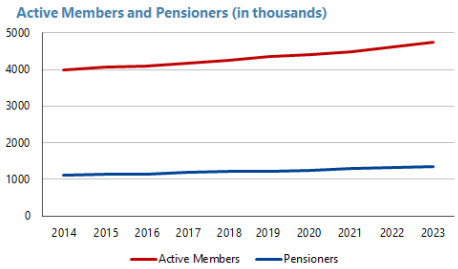
….and (in addition to increasing life expectation) also affect the conversion rate to annual annuities.



The Swiss pension system is still in accumulation phase due to the stronger increase in active members, even though the difference between contributions and benefits has been gradually falling since 2020.



The higher the share of active insurants in a pension fund, the longer the investment horizon and the more effective are potential measures for underfunded institutions.



Source: IMF staff calculation based on OECD, Swisscanto, SNB, FSO and OPSC data

C. Risks and Vulnerabilities

92. Investment rules attempt to balance investment limits and the principle of prudent investment, making it a very flexible regime. Regulation sets clear investment limits, which the

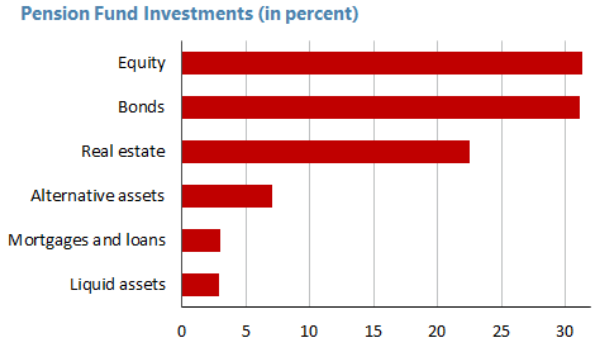
[30] Consequently, Swiss pensions are often classified as DB schemes in international surveys.

pension fund can exceed, provided it can demonstrate that it complies with the principles of prudent management, security, and diversification. Generous limits, however, rarely lead to pension funds exceeding the set limits. Bonds, equities and real estate cover 85 percent of pension funds' investments. A quarter of the assets include direct and indirect real estate investments and a small share of mortgages (three percent). While most investments are generally diversified across jurisdictions, real estate- related investments, i.e. physical property and mortgages, are concentrated in Switzerland.

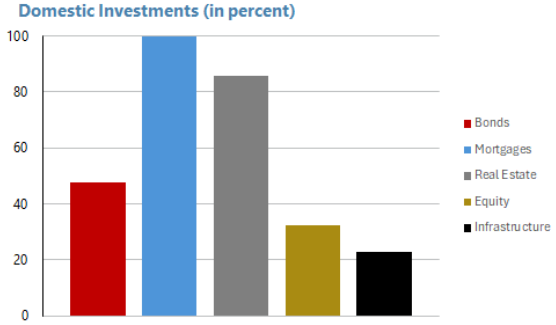
93. Foreign investments increase the diversification potential of investments but also expose the pension funds to non-negligible FX risks. More than half of the bonds and equities held are in foreign currency. This mitigates the home bias, which tends to strengthen in periods of market turbulence and thus the interdependencies between the macroeconomy and the sector. However, a significant share of FX risks remains unhedged, exposing the pension funds to currency risk.

Figure 30. Switzerland: Occupational Pension Fund—Asset-Side Exposures

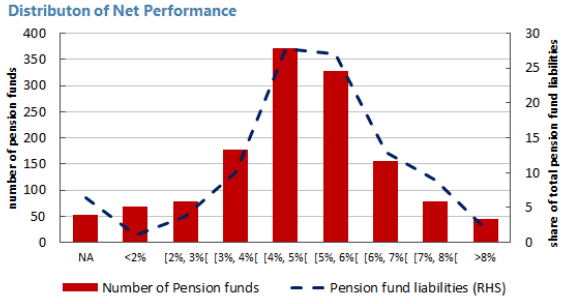
Although equity and bonds dominate overall investments pension funds have strongly increased their holdings in real estate and alternative assets.



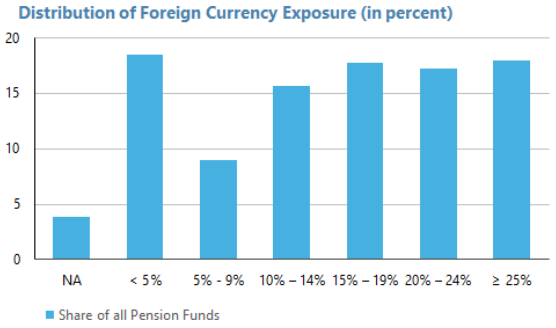
While real estate related investments are mostly domestic, other assets are more diversified.



Investment returns have been around five percent on average. Data do not suggest significant differences by size.



The majority of pension funds holds more than 15 percent of foreign-currency denominated assets, exposing them to a strengthening of the Swiss Franc.



Source: IMF staff calculation based on OPSC and FSO data. Figures are based on 2023 data.

94. Pension funds have increased their investment in riskier assets, thus exposing them to market corrections. One of the main drivers for a gradual increase in more risky assets was the low-interest rate environment. The increase in such investments was mostly at the cost of bonds. These higher risk assets are more prevailing in larger pension funds.[31] Although the investments remain high, the asset allocation has reversed somewhat due to higher yielding bonds. A sharp downturn in the Swiss real estate market could have a material impact on the financial health of pension funds, which have a large allocation to real estate. The average exposure is 23 percent relative to an investment limit of 30 percent. In addition, pension funds hold around three percent in mortgages and may also have some indirect exposure via investment funds. While not alarming at this stage, it is crucial to monitor the development of these exposures.

95. The net performance of investments has been highly volatile over the last years, varies widely across institutions but does not suggest significant differences by fund size. Capital weighted annual net returns on investment varied between ten percent in 2019 and minus nine percent in 2022. The average and median performance in 2023 was around five percent, with performance showing a bell-shaped distribution. Data do not suggest significant cost differences for asset management across different fund sizes.[32] Larger investors may achieve higher economies of scale in their investments but their higher exposure to alternative assets incurs higher costs. Overall, net performance did not show significantly different returns across different fund size.

Coverage Ratios[33] and Solvency

96. The coverage ratios, the extent to which assets cover a pension fund's liabilities, increased in line with the performance of the pension funds. The capital weighted ratio for pension funds without state guarantee was 115.6 percent in the first half of 2024. Correspondingly, the number of pension funds with a coverage ratio below 100 has fallen to less than one percent. Underfunded pension funds are mainly represented in pension funds with state guarantee, with a share of more than 80 percent. The state guarantee provides protection against insolvency but at the same time exposes the guarantor to potentially significant losses. Depending on the pension funds affiliation, the guarantor can be the local commune, the canton or the federal state. Thus, the fiscal strength of the guarantor varies significantly.

97. Coverage ratios over time appear to be correlated with financial market developments, but data also suggest that underfunded private pension funds generally recover quickly. A distinction is made between a minor underfunding and a significant underfunding. The former exists if the pension fund can restore its funding position within five years and without restructuring measures. In the latter case, the pension fund needs to provide a restructuring plan.

98. Long recovery periods and broad restoration measures ensure that pension funds are not forced to drastic actions in a short period of time. Pension funds have several restructuring

[31] See Swisscanto (2024): Schweizer Pensionskassenstudie 2024.

[32] Overall, large institutions may still have lower costs overall, due to considerably higher economies of scale for administrative expenses.

[33] Also referred to as funding ratio.

measures at their disposal to replenish their funds. The catalogue of measures covered in an OPSC directive includes contributions from employers and employees, restrictions on early withdrawals, release of an employer contribution reserve or falling below the minimum interest rate on retirement assets. Contributions from pension recipients are highly restricted and limited to the amount of pension indexation over the last ten years. The most appropriate measure depends on the respective circumstances and needs to be proportionate. Overall, it is expected that pension funds take measures that allow them to recover within a period of five to seven years, but no longer than ten years. Recovery contributions are mainly borne by the employers, even though the relative share has been gradually increasing for employees over the last years (from 15 to 30 percent).

99. Some pension funds' coverage ratios may appear stronger than they were if using standardized technical interest rates to discount liabilities. The applied technical interest rates are on average higher for pension funds with state guarantee than for private sector pension funds. In addition, target fluctuation reserves that are built to cover for capital market fluctuations are on average two percent lower. Together, this indicates that the gap in the coverage ratio is somewhat broader than the disclosed coverage ratios would suggest. Noticeably, this applies more to weaker funds than to well-covered ones. In 2019, the OPSC turned the guidance on technical interest rates (FRP4) into a minimum standard. It builds on the risk bearing capacity of pension funds and sets an upper bound (3.19 percent for periodic tables and 2.89 percent for generation table reflecting the need to adjust for increase in longevity for the latter) but leaves considerable latitude to the pension fund experts.

100. Fluctuation reserves have been run down considerably in the early phases of the interest rate hikes and have only been partially replenished by end 2023. The fluctuation reserve serves as a buffer against volatile capital markets. Depending on the asset allocation policy, it ranges between ten and twenty percent and is linked to an institution's investment strategy. The increase in interest rates and the high share of interest-rate linked investments led to a significant fall in its value in 2022, which has only partially been replenished.

101. Increasing life expectancy and low interest rates have led to a gradual fall of the conversion rate, with the statutory rate remaining unchanged since 2014. An average 1.5 percent difference between actual and statutory rates indicates that most pension funds provide benefits significantly beyond the regulatory minimum and are thus less affected by a non-actuarial conversion rate. An estimated ten percent of all pension funds are bound by the conversion rate of 6.8 percent as they only provide benefits at or close to the regulatory minimum. It mainly affects professions with lower salaries. The conversion rate is an implicit interest promise, which becomes increasingly challenging to achieve in light of increasing life expectancy and low interest rates compared to previous decades. Even ignoring administrative and management costs, keeping the conversion rate fixed, means that pension funds need to achieve higher returns to ensure that funds do not become depleted early and require intergenerational transfers from active insurants to retirees. In a low interest environment, this is increasingly difficult to achieve without raising the investment risk appetite.

102. Pension funds resort to compensatory measures, leading to a redistribution between generations, particularly for pension funds providing the regulatory minimum pension. Since

pension entitlements cannot be adapted after being awarded, increases in longevity and a fall in the technical interest rate will increase the technical reserves. There are several measures that pension funds can resort to, e.g. increases of contributions by employers and employees, one-off payments instead of permanent adjustments to benefits, linking pension benefits partially to capital market developments, etc.

Box 3. Switzerland: The Unsuccessful 2024 Pillar 2 Reform

In September 2024, the Swiss voting public rejected the reform to the Law of Occupational Benefits (LOB) by a two-thirds majority. The main objective of the reform was to strengthen Pillar 2 financing, in light of increasing life expectation and prolonged low interest rates relative to those implicitly assumed in the law. The changes would have mainly affected pension funds that provide benefits at or close to the statutory minimum. According to estimates by the FSIO, somewhat less than one third of active insurants would have been directly affected, mainly in professions with low salaries.

The following changes were suggested:

- Lowering the conversion rate from 6.8 percent to 6 percent, combined with compensatory measures: (i) Changing the coordination adjustment to a percentage of the salary (20 percent) instead of a fixed amount, thus increasing the insured amount of lower salaries; a fixed permanent increase of the pension for active members closer to retirement and subject to time to retirement and existing pension balance.
- Lowering the threshold for mandatory occupational pension contributions to an annual salary of CHF 19,845 compared to a threshold of 22,050 (both figures related to 2024) to ensure broader coverage.
- Adjustment to the annual pension contributions for different age brackets, leading to lower contributions (relative to status quo) for older employees

While there is general agreement that a conversion rate of 6.8 percent—corresponding to an interest rate guarantee of around five percent given current life expectation—is challenging, several arguments have been highlighted as reasons for the failure of the referendum, such as: insufficient communication of a highly technical topic, over-compensatory measures to the adjustment of the conversion rate leading to higher costs for pension funds in the short to medium-term or re-distributional elements in the reform.

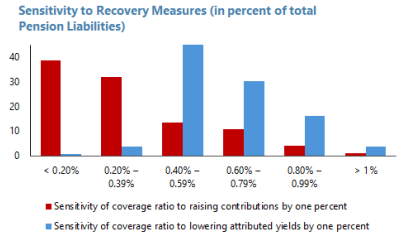
Overall, the immediate impact for the pension sector as a whole is low, given the small number of institutions providing coverage at or the near the statutory minimum (around 10 percent). Nevertheless, those institutions will likely be required to increase employee and employer contributions, and unintended inter-generational transfers may remain. Apart from that, we may consequently see a further push to a consolidation of the sector.

103. The increasing share of lump sum pension payments eases the pension funds' solvency position but may have social consequences. Pension funds have to accept a minimum of 25 percent in lump sum payouts but are free to allow higher withdrawals. In recent years, withdrawals have been on the rise, with complete withdrawals accounting for more than 40 percent in 2023, partial withdrawals add another 20 percent. It is noticeable that the median lump sum is consistently higher for those retirees that annuitize part of their pension funds relative to those that withdraw everything, suggesting that people with lower pensions are more likely to withdraw everything. Emigration of people that have only worked for a few years in Switzerland and return home may

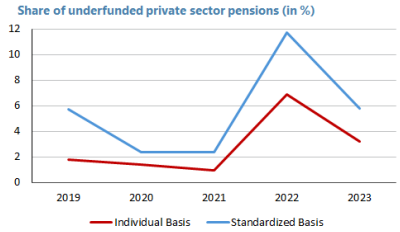
partially explain this difference. Motivations for lump sum vary and may be related to family situation, health, taxation, asset allocation preferences, etc. A concern is that it may lead to frontloading of consumption and an early depletion of available funds. In addition, pension funds are entitled to pay out small pension pots due to high administration costs. It remains to be seen whether the increasing tendency to withdraw the whole entitlement may lead to more required state support in the future.

Figure 31. Switzerland: Occupational Pension Fund—Risk Metrics

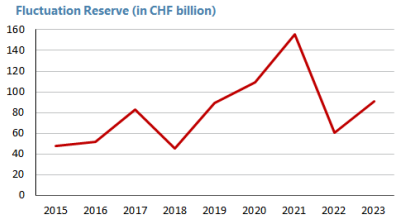
Within the statutory limits, lowering attributed yields is a more effective measure to improve funding levels.



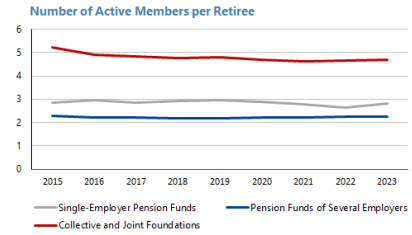
Some pension funds' solvency position would worsen if calculated on a standardized basis.



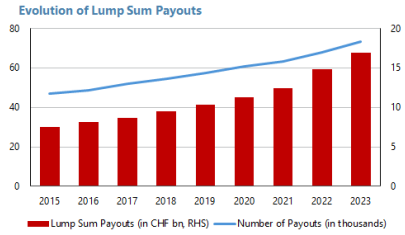
Changes in interest rates have had a significant impact on the value of the fluctuation reserves.



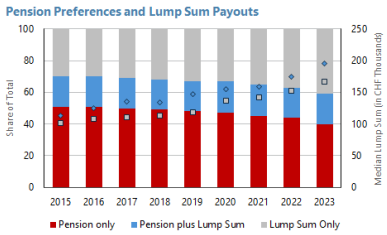
With a large majority of their members still active, collective and joint foundations are in a healthy financing position.



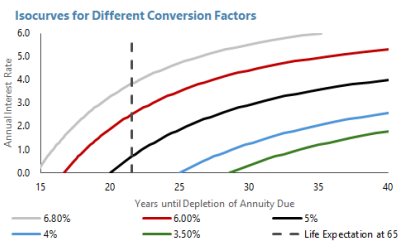
Lump sums are steadily on the rise….



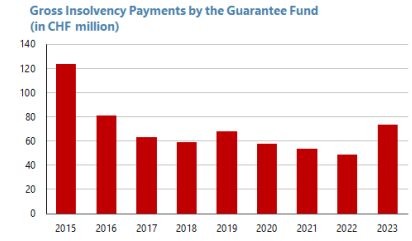
….with data suggesting that retirees on lower pensions are more likely to withdraw everything.



Pension funds providing the pensions at or near the regulatory minimum face challenges achieving the necessary returns.



Insolvency payouts by the Guarantee Fund have been stable and low over the last years.



Note: The isocurves show how long a pension pot lasts under different annual interest rate assumptions and given a specific conversion rate. It is assumed that the annuity pays out monthly in advance. Interest rates are assumed to be constant over time. The vertical line is the expected average life expectancy at the age of 65.
Source: IMF staff calculation based on FSO and OPSC data.

Insolvencies only have a modest impact on the Swiss pension fund system. Gross insolvency payments by the guarantee fund have been stable over the years and regularly amount to less than one hundredth of a percent of pension fund liabilities. Over the years, insolvencies have mostly affected small institutions, leading to a gradual growth of the reserve fund and subsequent falls of insolvency contributions (0.002 percent since 2023).

Joint and Collective Foundations

104. Joint and collective foundations benefit from a healthy ratio between active and retired members but face pressure from competition. For every retiree there are almost five active members compared to around three for single employer pension funds and a bit more than two for pension funds with several employers. In addition, they have a larger share of retirees that opt for a lump sum payout, thus reducing solvency risk from underestimating longevity risk or overestimating future financial performance but a need for careful liquidity planning.[34] In contrast to pension funds that are affiliated with a particular employer, joint and collective foundations face pressure from competition.

105. Companies switching their joint or collective foundation can impact the foundation's liquidity and solvency position. In addition to any risks stemming from a change in employee composition within a company, which every pension fund is affected by, joint or collective foundations face the additional risk of in and outflows of capital from switching employers. An employer can withdraw 100 percent of the accumulated retirement of its employees from an under-funded joint or collective foundation (to avoid contribution to necessary restoration measure, for instance), thus increasing the foundations' strains and potentially incentivizing others to follow suit. Capital inflows, on the contrary, may also dilute the coverage ratio if the related reserves are low. Furthermore, it may change the composition of active members and retirees. But the foundation is not required to accept the new company.

106. Several joint or collective foundations belong to a life insurer, thus requiring strict observance of adequate governance. Article 51c LOB requires any transactions to be at arm's length. Given the ownership structure of some foundations, it is important that supervisors pay particular attention to such transactions to avoid even the perception of unfair treatment of some involved stakeholders or any other conflicts of interest.

Outsourcing of Supervisory Responsibilities

107. Albeit not strictly precluded, the law does not envisage on-site inspections by the authorities. Auditing firms, paid by the supervised entity, inspect pension funds on-site. Concerns have been raised that standardized regulatory audit reports do not provide a sufficient level of individualization to different institutions. This reduces the extent to which idiosyncratic risks can be identified, thus reducing the value of such reports to the authorities. Supervisors should reduce the reliance on external regulatory auditors. Among other things, this requires that policymakers provide supervisors with the relevant authority to perform on-site inspections. Accounting for the large

[34] Liquid assets (as a share of total assets) have gradually fallen over the years, but data do not show significant differences across broader pensi0n fund categories. It is noticeable though that liquid asset holdings for joint foundations than for other pension funds (5.2 percent versus 4.2 percent on average across all funds.

number of institutions, such on-site inspection and more intrusive supervision should be performed in a risk-based manner, i.e. focusing on risk areas and institutions with the highest probability and impact.

INTERCONNECTEDNESS AND CONTAGION ANALYSIS

A. Methodology

108. The interconnectedness analysis primarily focused on contagion risks and vulnerabilities in the domestic interbank market. Using supervisory data on domestic interbank exposures, a network analysis and default simulations based on the Espinosa-Vega and Sole (2010) approach were employed to assess domestic vulnerabilities and spillover risk. The system-wide impact of a hypothetical default of each bank was modeled, including first order and spillover effects from additional rounds of induced failures. The simulations were used to compute the system-wide losses incurred from credit shocks when a counterparty defaults on its debt obligations and funding shocks that induce a liquidity shortfall for a counterparty funded by the defaulting bank (and the combination of the two shocks). Default was defined as the depletion of excess capital, calculated as the difference between total capital and the minimum capital requirement per bank (the latter defined to include Pillar 1 & 2 requirements and SIB surcharges; excluding CCoB and CCyB buffer requirements). The bilateral bank exposure data was available from 2014-24, therefore allowing the application of the model not only at a most recent point in time, but historically.

109. The default simulations were also conducted using cross-border exposure data from the BIS. BIS locational cross-border exposure data was employed to model the network effect of the assumed default of any one jurisdiction in the sample of 29 countries. The data captures banks' cross-border exposures to banks, NBFIs, governments, households, and nonfinancial firms. This analysis is subject to data availability constraints and limited to the 29 jurisdictions, including Switzerland, that report country-level counterparty claims.

B. Pre-Model Analysis

110. A high-level preliminary analysis of the structure of the Swiss financial system and cross-sectoral exposures informs the model-based approach. Sectoral exposure data shows that banks are highly exposed to OFIs, on par with the level of interbank exposures. Domestic banks have lesser exposures to pension funds, insurance corporations, investment funds, and MMFs (Figure 32). The magnitude of banks' exposures and the size of OFIs within the Swiss financial system imply that they may present contagion risk and have implications for financial stability. Bank's exposure to real estate investment funds specifically, which have a total estimated size of 14 percent of GDP, merit more scrutiny given the systemic risk profile of the real estate market in Switzerland[35]. The authorities may consider strengthening the data collection and dissemination mechanism for OFIs to better inform contagion risk analysis and identify potential sources of vulnerability.

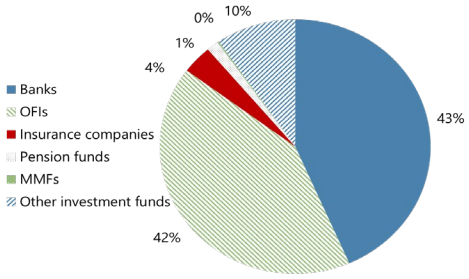
[35] See Section D and the separate FSAP Technical Note on Macroprudential Policy and Real Estate Risks.

111. BIS data shows that Switzerland's cross-border linkages are significant. Domestic banks are closely interlinked with several countries in the BIS sample. Swiss banks have significant claims and liabilities to seven countries (Figure 32), although the relative magnitude of these exposures is uneven. Switzerland had a total of USD 706 billion in cross-border claims as of 2024Q3, and USD 633 billion in liabilities.

Figure 32. Switzerland: Banking Sector Domestic and Cross-Border Exposures

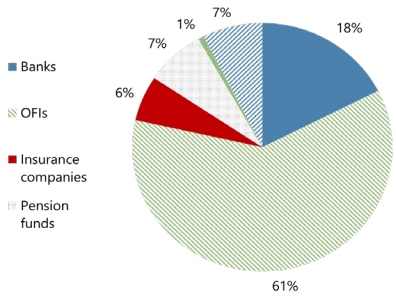
Swiss banks' claims on banks and OFIs are of comparable size.
Claims on other sectors are smaller.

B. Swiss Banks' Domestic Sectoral Claims
(share in total, end-2024)



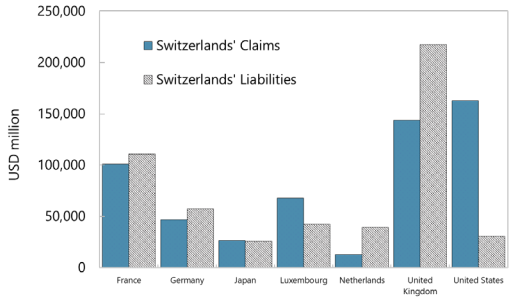
Swiss banks' liabilities to OFIs are substantial. Liabilities to other sectors, including interbank liabilities, are smaller.

B. Swiss Banks' Domestic Sectoral Liabilities
(share in total, end-2024)



Domestic banks have significant cross-border claims on several European counties, as well as the U.S. and Japan. Cross-border liabilities are largely concentrated in the UK. However, Switzerland accounts for less than 5 percent of the UK's total cross-border claims, implying relatively low contagion risk.

C. Swiss Banks' Cross-Border Claims and Liabilities
(USD million)



Source: SNB and IMF staff models and calculations.

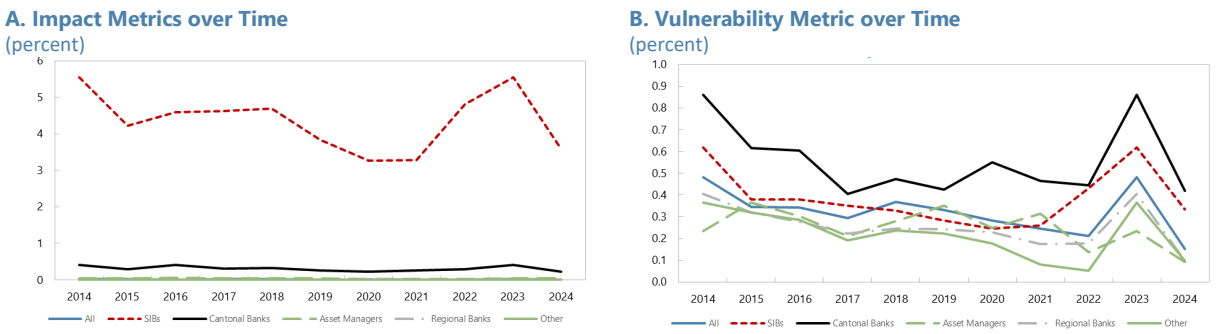
C. Default Simulations and Impact and Vulnerability Rankings

112. The hypothetical default of SIBs would, as expected, cause the most notable domestic spillover, while cantonal banks appear more vulnerable than other clusters. The default simulations result in two primary metrics: (1) an impact metric for each bank, calculated as the average loss to all other banks as a percentage of total excess capital, and (2) a vulnerability metric for each bank, defined as the capital loss to a given bank induced on average by all other banks defaulting (one after another), as a percentage of the bank's own excess capital. The results show that the contagion risk of SIBs has remained elevated over time. Cantonal banks appear more vulnerable to the hypothetical default of other domestic banks (Figure 33). The default simulations

have identified a few banks that have the potential to amplify spillovers through the Swiss banking system due to their simultaneous notable and persistent impact and vulnerability estimates.

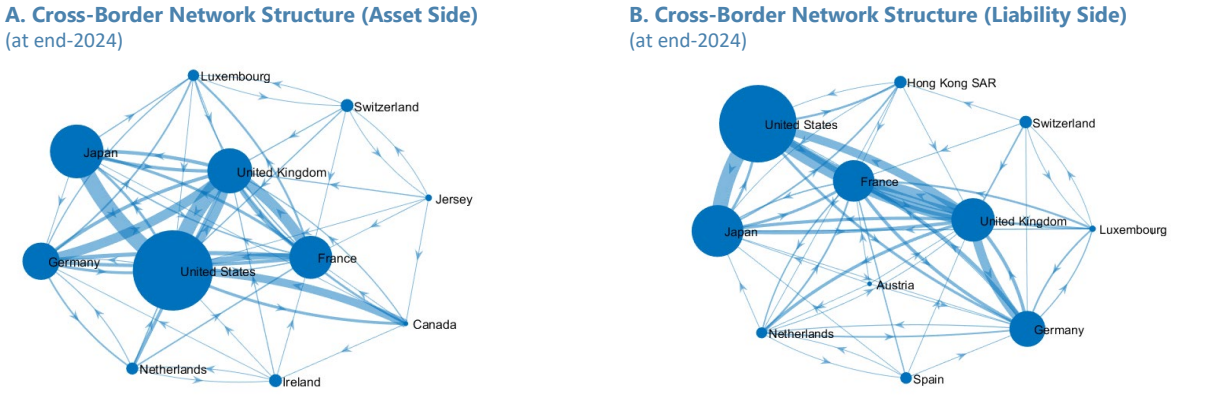
113. Switzerland is largely resilient to cross-border spillovers. The cross-border network contagion simulations suggest that Switzerland ranks 18th most vulnerable[36] to cross-border spillovers (Figure 34). Switzerland is particularly susceptible to cross-border contagion risks from the U.S., Japan, France, Germany, Italy, the Netherlands, and the UK. Switzerland ranks 10th on its impact metric for induced cross-border failures, indicating that the contagion risk from Switzerland is low.

Figure 33. Switzerland: Impact and Vulnerability Metrics



Source: SNB and IMF staff models and calculations.
Note: The impact metric measures the average capital loss induced to the banking system induced a bank defaulting, one after another. The vulnerability metric measures the average capital loss induced for a bank, on average after each other bank in the system was assumed to fail one after another.

Figure 34. Switzerland: Cross-Border Network Visualizations



Source: BIS and IMF staff calculations. This visual includes only Switzerland's ten largest exposures, on each side.

[36] The sample includes 29 jurisdictions that report jurisdiction-level counterparty claims in the BIS dataset: Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Ireland, Isle of Man, Italy, Japan, Jersey, Korea, Luxembourg, Macao SAR, Mexico, Netherlands, the Philippines, South Africa, Spain, Sweden, Switzerland, the United Kingdom and the United States.

CLIMATE RISK ANALYSIS

A. Pre-Model Analysis

114. Climate warming, population growth, and land use intensification could increase the effects of floods and their impact on households and banks. Switzerland has experienced an increase in both frequency and intensity of flood events; with an increase in Global Warming Levels (GWL), more intense heavy rainfalls will lead to more localized flooding and surface runoff, with evidence that large-scale floods could become more common (NCCS, 2021). While there is no clear trend in damages (Andres et al., 2019), as the population grows, the landscape is used more intensively, and flood hazards increase with climate warming, more assets could be at risk, with extreme flood events effects that could double under a 2-degree GWL (Munz et al., 2024). With banks having a significant exposure to mortgages[37] and non-amortization is a significant part of the portfolio, the increase in climate-related damages could impact households and banks.

115. The analysis used building location for building indicators, household microdata, and banks' canton-level exposure data. For the exposure, the analysis used three layers: residential building locations, household microdata from SILC and HBS, and the banks' mortgage portfolio distributions across cantons. The analysis leverages the residential building locations from the FSO to calibrate the flood-related indicators for assessing exposure, and the household microdata to calibrate the damage to real estate by major regions. The geographical mortgage exposure distribution varies by bank, with higher geographical concentration among cantonal and regional banks (Figure 35). The geographical distribution was used to assess the banks' exposures at a cantonal level to three different flood-related metrics and to calibrate the bank-specific impact using the damage to real estate by major region and the banks' exposure at the same geographical level.

116. Data on physical hazards from different sources have helped assess various dimensions of flood risk. Regarding current conditions, one indicator considers the percentage of residential buildings in flood zones for each canton using flood data from the Federal Office of the Environment (FOEN) and residential building data from FSO (Building and Housing Statistics – GWS), translating the return periods into an average annual percentage of buildings at risk[38] for having a single indicator.[39] For future conditions, a second indicator entails the relative change of average annual flood depth using World Resources Institute (WRI) flood maps and residential building data. For event-related impacts, the flood dynamic scenarios from Munz et al. (2023)[40], which consider nine flood events, were defined as the probability of being affected and the damage rate (i.e., the damage given that a building is affected) at the cantonal and major region levels. The first two indicators identify the risk in each location but do not show the relation between locations. At the

[37] See the Section on Housing Markets and Mortgage Credit.

[38] A return period indicates how likely a hazard event will occur at or above a specific intensity within a time frame defined by a probability; e.g., a 1-in-100-year return period means there is a 1 percent chance of the event occurring in any given year. The average annual percentage at risk corresponds to the sum for all return periods of the probability associated with return periods times the percentage at risk for each return period.

[39] Appendix I, Figure I1 illustrates the calculations of the hazard indicator.

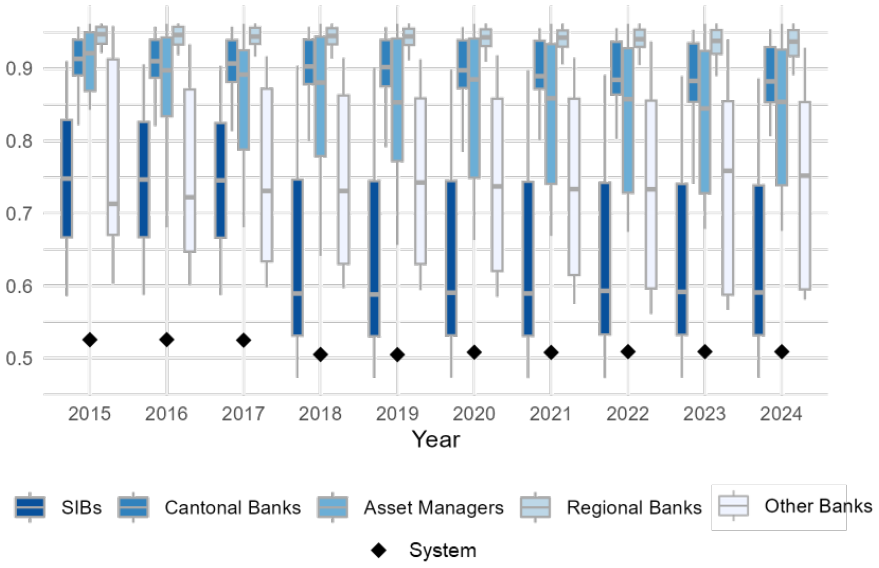
[40] Appendix I, Table I1, and Figure I2 show the different events' characteristics, and the distributions of probability of being affected and damage rate by canton from the different events.

same time, the flood dynamic scenarios cover the relationship between locations as they depict how they could be jointly affected by a specific event; due to this, the hazard data was used to assess the acute risk impact.

117. Banks' exposure to different physical hazards varies by bank and indicators, with cantonal and regional banks showing the highest indicators in the worst-case scenario. While the banking system aggregate mortgage exposure is higher in some cantons, these cantons do not face the higher current risk or expected future increases (Figure 36). Regarding geographical distributions by bank clusters, regional and cantonal banks show the highest actual exposure, and for cantonal and asset and wealth management banks the risk could increase.[41] Among plausible flood events, the worst-case scenario shows significantly greater effects across all banks, and for the different types of institutions (Figure 37); this scenario serves as the scenario for the acute risk impact assessment on LGDs.

Figure 35. Switzerland: Geographical Mortgage Exposure Concentration

Regional mortgage exposure concentration is contained at banking system level, while cantonal and regional banks face higher geographical concentration levels.



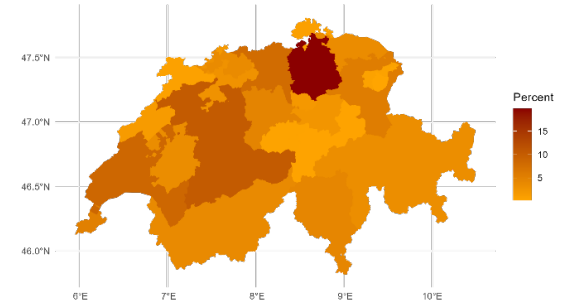
Sources: SNB, FINMA, IMF staff calculations

[41] Appendix I, Figs. I3 and I4 show the bivariate distributions of the banking system exposures, and Figure G5 shows the banks' distributions of weighted average indicators.

Figure 36. Switzerland: Banks' Exposure Assessment

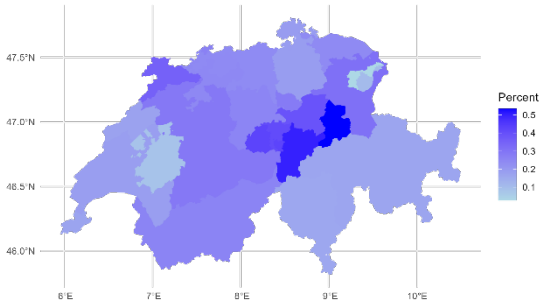
Banking system aggregate mortgage exposures are concentrated in some cantons…

Distribution of Newly Granted Mortgages
(percent of total loans 2015 -2024)



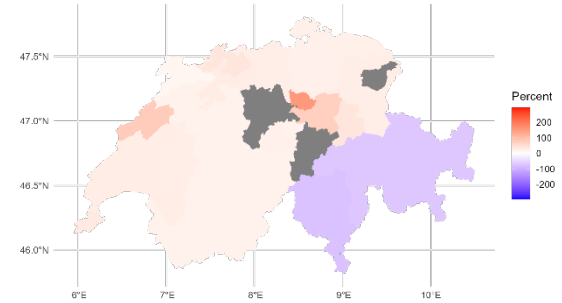
…although not all are equally exposed to river floods.

Average Annual Buildings on Flood Zones
(percent of buildings)

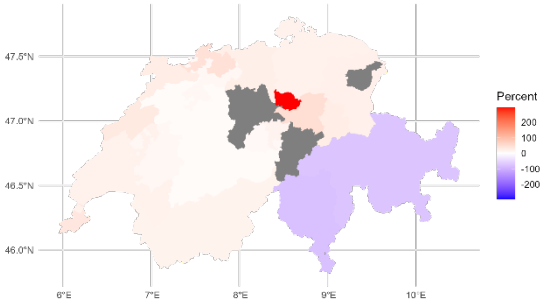


Under future climate conditions, some cantons could be more affected than others due to changes in flood risk

Relative Change Average Annual Flood Depth RCP 4.5
(in percent)



Relative Change Average Annual Flood Depth RCP 8.5
(in percent)



Sources: SNB, FINMA, FOEN, WRI, swisstopo, IMF staff calculations

Note: For cantons in grey, the relative change values are not available.

Figure 37. Switzerland: Flood Dynamics Actual Conditions

Flood Scenarios Banks' Exposure Weighted Distribution
(percent)

Sources: SNB, FINMA, Munz et al. (2023), IMF staff calculations

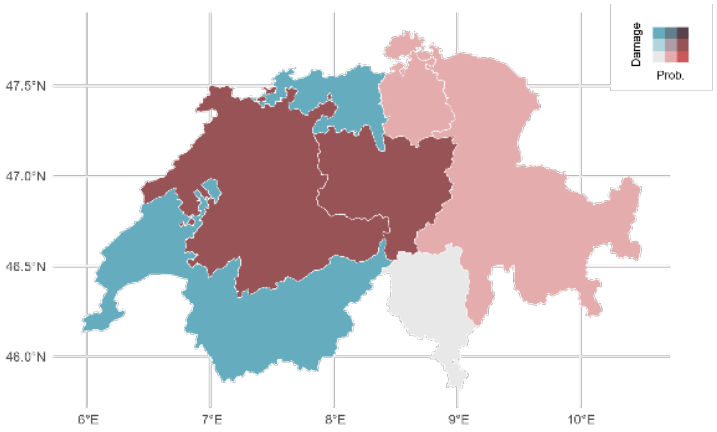
Notes: The indicator corresponds to the probability of being affected times the damage rate weighted by the banks' loans.

B. Methodology

118. A climate risk scenario analysis was conducted for banks' mortgage portfolios and a physical risk focus. The physical risk scenarios considered flood risk and Representative Concentration Pathway[42] (RCP) 8.5 conditions. The impact on the household sector was assessed through the physical risk-induced damage to the real estate (acute) and the additional financial burden (chronic). That is, the impact on households could affect the banks via two channels: loss-given default (physical damage that reduces the value of real estate collateral) and default probabilities (through rising insurance premiums), thereby raising credit costs for banks. The analysis considered the worst-case scenario (Figure 38) from the nine flood scenarios under current and 2-degree GWL (Munz et al., 2024) and the increase in annual expected damage from river floods for increasing the insurance premiums. The impacts are bank-specific, depending on their geographical footprint at a major region level, and leverage the microdata and the mortgage portfolio model of the bank solvency stress test.

Figure 38. Switzerland: Scenario Flood Impact Assessment

Worst-Case Flood Scenario—Actual Conditions
(probability of being affected and damage rates by major region categorized into three groups using quantiles)



Sources: Munz et al. (2023), swisstopo, IMF staff calculations.

119. The impact on property values and the increase in insurance expenses, derived from the micro-data and banks' mortgage exposure distribution, were used to estimate the effects on banks. The impact on property values estimation entailed the use of household micro-data, the probability of being affected, and the damage rate, the last two from the worst case flood event, and a 2-degree GWL, and then sampling over the different households combinations to obtain a property value impact distribution for each major region[43], using the average in the tail of this

[42] An RCP is a greenhouse gas concentration trajectory used in climate modeling and research. RCPs provide different scenarios of future atmospheric greenhouse gas concentrations based on varying levels of emissions, land use changes, and other factors influencing climate change and were first introduced in Coupled Model Intercomparison Project Phase 5 in the context of the Intergovernmental Panel on Climate Change Fifth Assessment Report.

[43] Switzerland has seven major regions, defined by the FSO on the basis of the cantonal division, i.e., each major region is defined as one or a group of cantons; they are equivalent to NUTS2 regions of EUROSTAT and TL2 of the

(continued)

distribution (top 5 percent). The increase in insurance expenses considered a single value of average annual flood damages, corresponding to the median under RCP 8.5 for mid-century for Switzerland from NGFS, which exceeded the relative changes estimated with WRI[44]. This consideration also accounts for the risk sharing among insureds and insurers in the current building insurance setup (Box 4). The average annual flood damages relative change was applied to each household's building insurance expenses; the weighted average increase in building insurance expenses for households with mortgages serves as the input to the model.

Box 4. Switzerland: Building Insurance

Building insurance in Switzerland is provided through two different systems operating in different cantons. In 19 cantons, the insurance is provided through local public sector insurers, Kantonale Gebäudeversicherungen (KGVs), which are not-for-profit organizations. The remaining cantons, Geneve, Uri, Schwyz, Ticino, Appenzell Innerrhoden, Valais, and Obwalden (GUSTAVO cantons), protection is provided by private insurance firms. Insurance is compulsory for all buildings in cantons with public sector insurers and in three of the GUSTAVO cantons, with insurers in the GUSTAVO cantons being supervised by FINMA. Both public and private systems operate under the principle of double solidarity (Jarzabkowski et al., 2022), that is:

- **Solidarity among insureds:** In the public system, KGVs charge the same price (as a percentage of insured value) independently of the risk of the location of the specific property, reflecting a risk profile for the canton. The same price is charged across all GUSTAVO cantons in the private system, reflecting a risk profile reflective of the seven cantons.

- **Solidarity among insurers:** In the public system, an inter-cantonal fund for excess losses is jointly financed by the KGVs and managed by the Intercantonal Reinsurance Association (IRV), which negotiates reinsurance deals for the KGVs. A similar scheme for excess losses exists in the private system through a compensation fund among private insurers.

In addition to insurance, the KGVs also cover response and prevention, with the first aim being to financing training and equipment of response brigades, and the latter focusing on intervening in the building permission stage, promoting and financing damage-reducing improvements, collaborating with risk mapping, and in the definition of projects to reduce risk and damages.

120. Household PDs are affected by rising insurance costs, while LGDs are affected through the loss of real estate collateral due to physical damage. The structural micro-macro simulation model (IDHBS+)—as employed in the solvency stress test and for the macroprudential policy analysis—was used to estimate the impact of physical damage on properties and the increase in insurance expenses into PDs and LGDs. Regarding PDs, the model maps the increase in insurance expenses into rising household consumption (which contains insurance expenses as one component). By assumption, this shift in expenses is the same for all households. The change in expenses leads to a change in PD. Regarding LGDs, the model captures the physical damage that

OECD. The major region-canton correspondence is as follows: Lake Geneva region – VD, VS, GE; Espace Mittelland – BE, FR, SO, NE, JU; Northwestern Switzerland – BS, BL, AG; Zurich – ZH; Eastern Switzerland – GL, SH, AR, AI, SG, GR, TG; Central Switzerland – LU, UR, SZ, OW, NW, ZG; and Ticino – TI.

[44] Appendix I, Figure I6 shows the maximum annual average damage relative change under RCP 4.5 and 8.5 estimated with WRI and Huizinga et al. (2017).

translates into a loss of real estate values, by major region. The LGD effect was computed in a bank-specific manner, by taking their regional mortgage exposure profile and the associated regionally differentiated physical risk impact into account. The PD and LGD impacts are then combined to obtain a total capitalization impact for all banks.

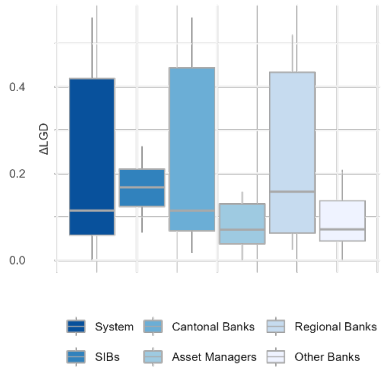
C. Results

121. An extreme flood scenario would let the value of the real estate drop notably, with the LGD channel adversely affecting bank capital more than through PDs (via increasing premiums). While most of the regions would be affected in the different flood scenarios, the impacts would be significantly higher in the Worst case and 2-degree GWL. This scenario was translated into house price impacts in the regions and then to LGD impacts. The most pronounced impacts were estimated for cantonal and regional banks (Figure 39). This result is explained by a combination of more notable mortgage exposure and their provision to flood-exposed regions. Under the assumption that insurance coverage of losses will prevail in the future, the LGD impacts are nullified.

Figure 39. Switzerland: Physical Climate Risk Impact on Banks

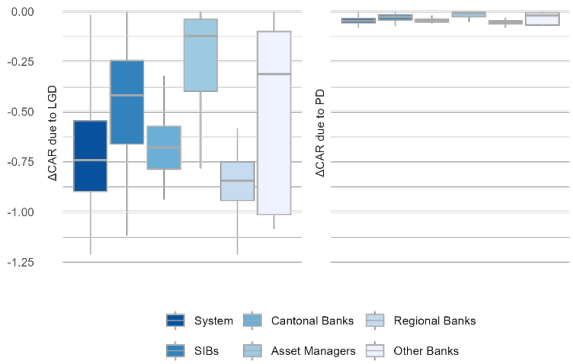
The LGD impacts vary by banks and bank clusters due to their differential geographical exposure.

Distribution of Impacts on Banks' LGD
(shift in LGD in percentage points)



The effects on bank capital ratios depend on the size of their mortgage portfolios.

Distribution of Impacts on Banks' Capital Ratio
(shift in capital ratio in percentage points)



Sources: IMF staff calculations

122. Physical climate risks can impact the banking system, but insurance transfer mechanisms limit its impact. The impact of physical risk materialization is seen as independent of cyclical economic conditions. While premiums could increase structurally, the setup of the Swiss compulsory building insurance system helps to redistribute the risk, avoiding adverse selection and helps stabilize price fluctuations, given the double solidarity principle: among insureds (same premiums within cantons) and insurers (inter-cantonal fund, and compensation fund in GUSTAVO cantons), and considering prevention on top of this. The estimates are limited to the specific set of flood events that were analyzed here, i.e., the trade-off could be more pronounced due to the effects of other phenomena for regions not affected in the scenario.

HOLISTIC VULNERABILITY ASSESSMENT OF THE SWISS BANKING SECTOR

A. Methodology

123. The holistic vulnerability analysis combines the information contained in numerous indicators, regarding contemporaneous conditions and forward-looking model results. This is meant to help synthesize the information contained in the various indicators, in turn to identify potential "weak spots" in the system. The indicators pertain to initial conditions regarding solvency, profitability, liquidity, and large exposures. The forward-looking indicators comprise metrics from the solvency and liquidity stress tests, the vulnerability indicator from the default simulations in the interconnectedness context, and a climate exposure metric (Table 3). There are 20 metrics in total.

Table 3. Switzerland: Holistic Vulnerability Analysis—Metrics and Weights

Dimension		#	Metric	Orientation for ranking	Weights						#
Initial conditions	Solvency, profitability, efficiency, market risk exposures	1	Regulatory capital ratio (CAR)	+	25%	45%				1.6%	1
		2	Excess capital ratio (ExCAR)	+						1.6%	2
		3	Return on assets (ROA)	+						1.6%	3
		4	Net interest margin (NIM)	+						1.6%	4
		5	Cost of risk (COR)	-						1.6%	5
		6	Cost to income ratio (CTI)	-						1.6%	6
		7	Share of fair value exposures in total assets	-						1.6%	7
	Liquidity	8	Cash and reserves over total liabilities	+		45%				2.8%	8
		9	Unencumbered assets over total liabilities	+						2.8%	9
		10	Non-household liabilities in total liabilities	-						2.8%	10
		11	Off+on-balance sheet over on-balance sheet assets	-						2.8%	11
	Large exposure	12	Top-20 exposures over capital	-		10%				1.3%	12
		13	Sector concentration among top-20 exposures (Gini)	-						1.3%	13
Forward-looking vulnerability analysis	Solvency	14	Solvency ST: Total CAR low point minus T0	+	75%		45%	25%		8.4%	14
		15	Solvency ST: Total CAR low point minus min req.	+				75%		25%	15
	Liquidity	16	Liquidity ST: Percent drop in UCLA up to 6 months	+			40%		90%	27%	16
		17	Cumulative funding gap after 1-month (from LMT)	+					5%	1.5%	17
		18	LCR	+					5%	1.5%	18
	Interconnectedness	19	Default cascade simulation: Vulnerability metric	-			10%			7.5%	19
	Climate	20	Climate exposure metric	+			5%			3.8%	20

Sources: IMF staff.
Notes: The table summarizes the bank-level indicators that are involved in the holistic vulnerability analysis. The weights sum to 100 percent in each column under the label "weights." They are used to compute weighted rankings based on metric-specific ranks.

124. All twenty metrics are used to compute indicator-specific ranks first, to then derive composite rankings, involving weights for each indicator. The weights are judgmentally set. The weights related to initial conditions vs. forward-looking results are set to 25 and 75 percent, respectively (Table 3). The bank cluster-specific distributions of the bank-level data for all 20 indicators is collected in Appendix A, Figure A6.

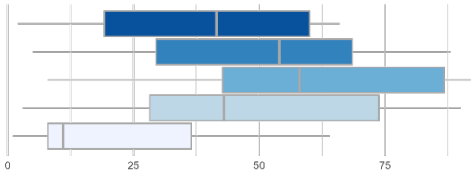
B. Findings

125. Based on initial conditions, the residual cluster of banks, followed by SIBs and regional banks, are the comparably weakest. The residual cluster's weak performance is explained by a combination of lower initial capital ratios, weaker ROA, higher cost of risk and cost to income metrics, and regarding liquidity, for example, their lower unencumbered asset-liability coverage (Figure 40).

Figure 40. Switzerland: Holistic Vulnerability Analysis—Composite Metrics by Bank Cluster

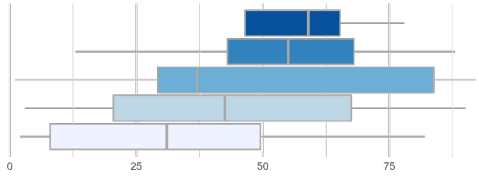
Based on initial conditions, the residual cluster of banks, followed by regional banks and SIBs, are the comparably weakest in cross-cluster comparison.

Composite Vulnerability Ranking—Initial Conditions
(distributions of banks' ranks, from 1-92, smaller means more vulnerable)



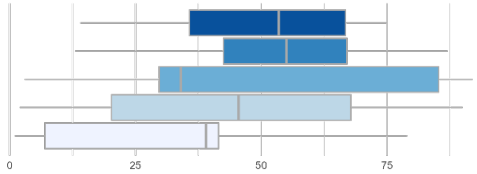
Based on the forward-looking analyses, the residual cluster of banks, followed by cantonal banks and asset/wealth managers are the comparably weakest.

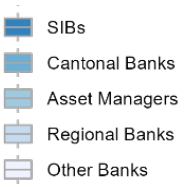
Composite Vulnerability Ranking—Forward-Looking
(distributions of banks' ranks, from 1-92, smaller means more vulnerable)



Given the high weight assigned to the forward-looking analysis, the overall composite rankings resemble to an extent the forward-looking ranking of bank clusters.

Composite Vulnerability Ranking—All Metrics Combined
(distributions of banks' ranks, from 1-92, smaller means more vulnerable





Sources: SNB, FINMA, and IMF staff models and calculations.
Notes: The composite ranking distributions are based on bank-level rankings of 92 banks. The rankings and distributions do not involve any bank size weights.

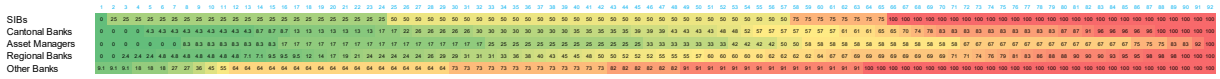
126. Regarding forward-looking conditions, asset managers and SIBs appear comparably stronger, followed by regional and cantonal banks. The ranking-based results for asset and wealth managers are not that negative (despite the sizeable solvency impact for them) due to these banks' more favorable starting point solvency conditions, their mid-field performance regarding liquidity stress test results, and their comparably more limited exposure to climate risk.

127. The overall composite rankings combining initial conditions and forward-looking metrics largely resemble the cross-cluster ranking from the forward-looking analysis. The weaker initial conditions for SIBs bring the SIBs' composite rank distribution closer to those of cantonal banks. All other cross-cluster rankings, regarding the median, are aligned between the forward-looking and overall composite rankings.

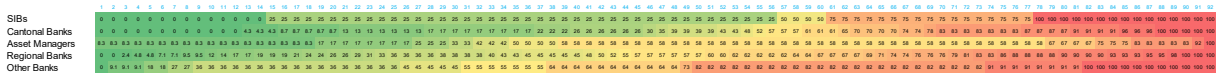
128. A detailed bank level analysis of the holistic vulnerability matrix suggested a modest correlation between weakness in solvency and liquidity terms and found one bank that is impactful and vulnerable at the same time. Selected regional banks appear vulnerable regarding liquidity, but that subset of banks appears comparably resilient in solvency terms. Overall, the correlation between solvency and liquidity weakness was modest. Further, one bank was identified which is impactful and vulnerable at the same time, according to the metrics derived from the default simulations in the context of the interconnectedness analysis. This finding squares with the assessment of the authorities and was discussed accordingly.

Figure 41. Switzerland: Holistic Vulnerability Analysis—Share of Banks by Cluster, from Least to Most Vulnerable

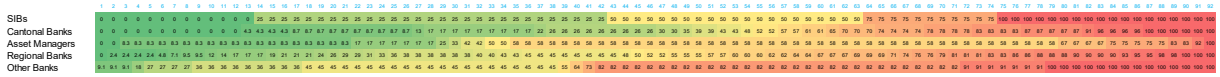
Cumulative Count of Banks on their Vulnerability Ranking, Least to Most Vulnerable (left-right)—Initial Conditions
(count of banks relative to the number of banks per cluster, in percent)



Cumulative Count of Banks on their Vulnerability Ranking, Least to Most Vulnerable (left-right)—Forward-Looking
(count of banks relative to the number of banks per cluster, in percent)



Cumulative Count of Banks on their Vulnerability Ranking, Least to Most Vulnerable (left-right)—Overall Composite
(count of banks relative to the number of banks per cluster, in percent)



Sources: SNB, FINMA, and IMF staff models and calculations.
Notes: The tables show the counts of banks, relative to the number of banks per cluster in percent, for all 92 banks from left to the right. The color coding serves as a visual support to see in which cluster the banks start adding to the vulnerable bank count before those of other clusters. The rankings and distributions do not involve any bank size weights.

RECOMMENDATIONS

A. Banking and System-Wide Risk Analysis

129. The authorities are recommended to collect more data in various dimensions, to enhance their risk analysis. Specifically:

- For banks, default rates at bank-portfolio level, and other related parameters such as NPL cure rates, for all banks, historically (i.e., retrospectively if feasible) and forward in time, may be collected; the authorities' forthcoming loan-level data set (expected to be operational in 2027) will be useful in this context, and should ideally allow obtaining debt metrics, e.g., DSTIs as a flow-flow debt service metric, pertaining to total debt of a debtor;

- Regarding mortgage lending, obtain information on a regular basis for features such as amortizing and non-amortizing loan contract modalities and their shares in banks' loan books;

- Banks' interest income and related rates consistently for outstanding balances and new business at bank-portfolio level, with sufficient portfolio granularity, for all banks;

- Detailed coverage of Lombard loans and all their risk parameters, especially for asset and wealth management banks, and other large banks that engage in this business;

- Detailed and systematic data across banks (i.e., beyond SIBs) for their trading and investment portfolios. Instrumental to collect would be data with a split into HFT, and for the investment portfolio exposures a split into AFS and HTM, different duration metrics (such as residual duration, Macaulay duration for bond exposures), book and market values for HTM and AFS bond exposures, and information about the types and composition of banks' holdings in collective investment schemes. Recommended dimensions for all such metrics include

counterparty splits (nonfinancial corporate45, financial corporate, sovereign), geography (domestic, foreign, specific other countries), and instruments (money market instruments, bonds, equity, etc.).

- More data for the detailed components of banks' fee and commission income and expenses (though primarily in relation to income);
- Bilateral exposure data beyond banks, including all NBFI types operating in Switzerland;
- More data related to CRE firms, their activities, financial health, recourse to market vs. bank borrowing, the extent of collateralization for their borrowings; alongside more data for banks' CRE exposures (related risk parameters, etc.) and information about the non-bank creditors that provide bond-based finance to the CRE firms.
- Transaction price indexes for commercial real estate should be developed (currently, only ask price measures and rent prices exist in this context);
- Regulatory data for banks' foreign exposures should be improved, for example, to be able to identify foreign CRE exposures and their risk parameters.

130. The authorities are recommended to further develop their models, in various dimensions. Specifically:

- Keep developing micro data-based models for nonfinancial corporates, including as an input to bank solvency stress testing;
- Consider developing a micro data-based model for the household segment; this FSAP has employed one such model that illustrates how one can go about this, using micro data from the FSO (SILC and HBS);
- Develop a liquidity stress test model, having all banks from Switzerland in-scope;
- Augment the solvency stress test model to include asset and wealth management banks;
- Extend the scope of network analysis and contagion modeling beyond banks, to include NBFIs (link to data collection in this regard, see above).

131. The authorities are recommended to keep examining banks' valuation models for real estate collateral. Given the significance of the housing market and mortgage lending in Switzerland, FINMA is recommended to keep examining the banks' valuation models for real estate collateral at origination, as well as the appraisal and re-evaluation processes along the lifetime of outstanding loan contracts. This is to ensure that appraisals be conducted in a prudent manner, not resulting in upward biases, and for valuations to be sufficiently frequent.

132. FINMA and the SNB are recommended to collaborate regarding the reciprocal benchmarking of bottom-up and top-up stress test results and the underlying models.

[45] It is recommended to further split the NFC segment, e.g., by separating CRE exposures.

Bidirectional feedback and joint work would benefit both the TD and the BU analysis, for further improving the TD models and for conducting quality-assurance of the BU results.

133. The authorities should closely monitor the mortgage LTVs for all banks. This is relevant in view of the recent loosening of the LTV cap in the residential investment property segment. Should the share of mortgage loans with unduly high LTV ratios increase, the authorities should consider adequate policy responses, e.g., via binding borrower-based measures.[46]

134. The 2019 FSAP recommendation is reiterated, to consider abolishing the tax deductibility of mortgage interest payments. As discussed earlier in this note (Box 2), the current tax regime provides incentives for households to take on more mortgage debt than they otherwise would. This is one factor that contributes to a high level of mortgage debt and increases household vulnerabilities. It is warranted, therefore, to consider removing the tax deductibility feature. A more in-depth follow-up analysis on the side of the Swiss authorities will help corroborate this recommendation further.

135. The SNB is recommended to publish more details in its FSR, related to macro-financial scenarios and its stress test results. The SNB should consider providing more quantitative information regarding the stress test scenarios and bank stress test results in its FSR, as is common practice at central banks in other jurisdictions.

Insurance

136. FINMA is recommended to implement top-down liquidity stress testing to identify potential sources of stress for insurers. To support internal analyses, FINMA should collect detailed derivatives data as well as surrender and lapse information by type of insurance product. The recently introduced detailed asset template that supports the prudent person principle provides the level of granularity needed to support the analysis of derivatives exposure. Given the nature of liquidity risk, it is recommended to increase the reporting frequency beyond annual.

137. Reducing the dependence on ad-hoc data requests would be desirable. Data collections for insurers during the pandemic have shown that Swiss insurers are able to provide reliable data efficiently. Nevertheless, it is important for supervisors to have data available on a regular, standardized basis to support regular monitoring and be less reactive. This supports potential early identification of challenges that can feed into on-site inspections and deepen offsite thematic analyses.

138. FINMA should continue to closely monitor spread risks and real estate-related exposure, including any risk mitigating techniques and valuation approaches applied. Spread risk and property risk are the main macro-financial drivers of Swiss insurers' solvency position. Those insurers with a large property portfolio, combined with a sizable mortgage book and other real estate-related assets are particularly exposed by a real estate shock.

[46] An extended recommendation and additional background in this context are provided in the companion FSAP Technical Note on Macroprudential Policy and Real Estate Risks.

B. Pension Funds

139. As highlighted in the 2019 FSAP, data gaps and lack of transparency in a pension fund context significantly compromise market-wide analyses. Official statistics are collected on an annual basis and are only available with considerable delay. As data from 2022 show, changes in market environments can have a significant impact on pension funds' funding position, the aftermath of which can only be analyzed several months after the end of the year. While it may not be efficient to monitor the entire market given the sheer number of small institutions, the authorities should take a risk-based supervision approach, identifying clusters of entities that they monitor more regularly and more intensively. Such analyses should include both public and private pension funds, as well as a subset of single and multiple employer pension funds but in particular, joint and collective foundations due to their size and insufficient transparency. Given the on-going consolidation in the market, a significant market share can be captured by a comparatively small subset of institutions.

140. Further convergence of technical bases and transparency is needed, including the possibility for authorities to intervene. High-level data indicate some level of euphemistic reporting of coverage ratios. While pension funds generally use the latest, more conservative life tables available, data show that there is considerable variation in the choice of technical interest rates and the fluctuation reserve. A high interest rate is not only an assumption of expected future returns—which may impact their asset allocation strategy – but also inflates the funding level of the respective institution. A low fluctuation reserve may not fully capture the asset side risks. Crucially, data suggest that weaker institutions apply more generous assumptions. In other words, their actual coverage ratio is worse than presented, with corresponding impact on the (choice of) the necessary restoration measures. It is crucial that relevant cantonal authorities have the instruments and authority to intervene when they identify discrepancies, with respect to the funding position but also more generally.

141. A formal platform to discuss market/sectoral developments and potential risks to financial stability should be established. It should all authorities involved in pension supervision, i.e. cantonal supervisors, OPSC and FINMA. Where applicable, the findings thereof should be fed into the discussions of the Steering Committee/Standing Committee for Financial Stability, with corresponding representation of the pension authorities at the committees, when pension issues are tabled.

C. Climate Risk Analysis

142. The authorities are recommended to collaborate with agencies and institutions that are developing climate-related work in the country. In addition to further collecting data from banks, the Swiss authorities are recommended to keep sourcing information from and collaborating with building insurers, FOEN, and other agencies and research institutions, to develop their capacity to further analyze climate risk and its implications for the financial system specifically and the Swiss economy and population at large.

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Appendix I. Additional Data

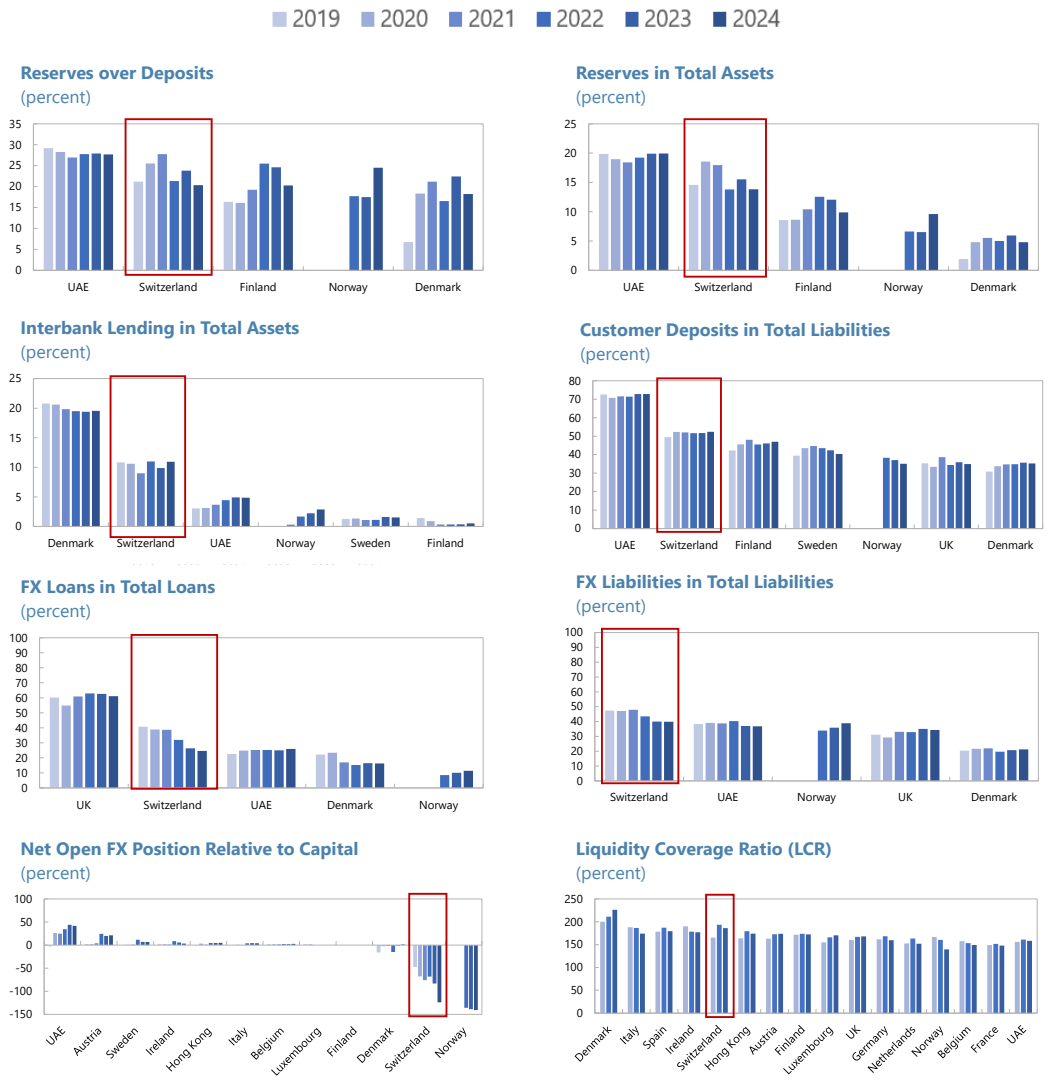
Appendix I. Figure 1. Switzerland: Banking System—Balance Sheet Structure and Solvency

Sources: Financial Soundness Indicators (FSI), Monetary and Financial Statistics (MFS), WEO, and IMF staff calculations.

Appendix I. Figure 2. Switzerland: Banking System—Profitability

Sources: Financial Soundness Indicators (FSI) and IMF staff calculations.

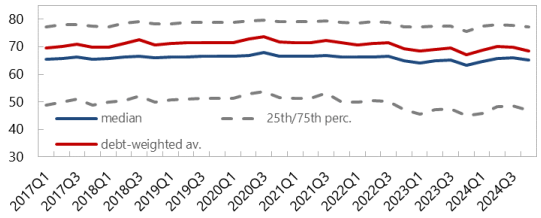
Appendix I. Figure 3. Switzerland: Banking System—Liquidity and FX Characteristics



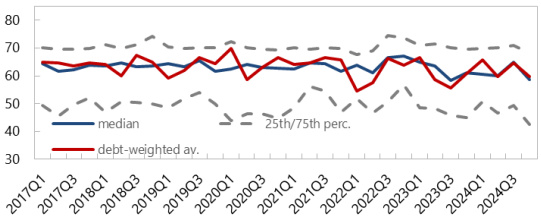
Sources: Financial Soundness Indicators (FSI) and IMF staff calculations.

Appendix I. Figure 4. Switzerland: Loan-to-Value (LTV) Ratios for New Mortgage Lending

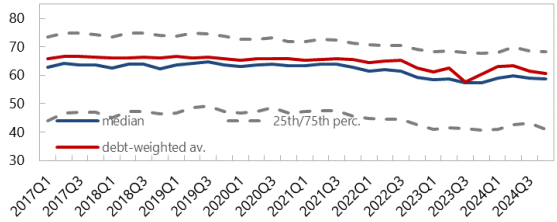
A. LTVs for Owner-Occupied Housing
(percent, debt-weighted av. for new lending and refinancing)



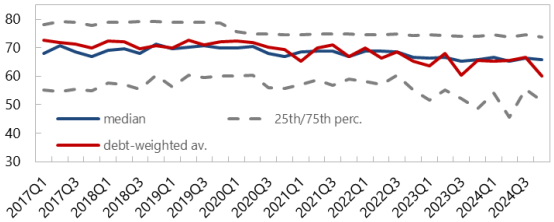
B. LTVs for Commercial Real Estate
(percent, debt-weighted av. for new lending and refinancing)



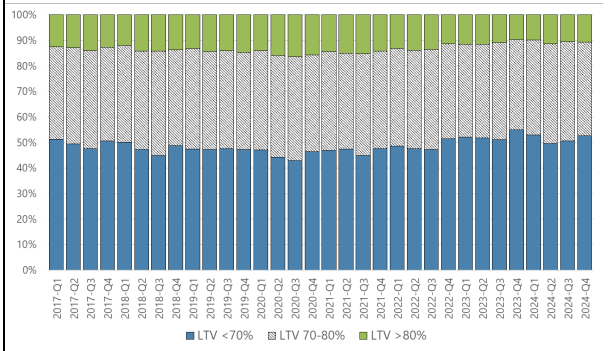
C. LTVs for Buy-to-Let by Households
(percent, debt-weighted av. for new lending and refinancing)



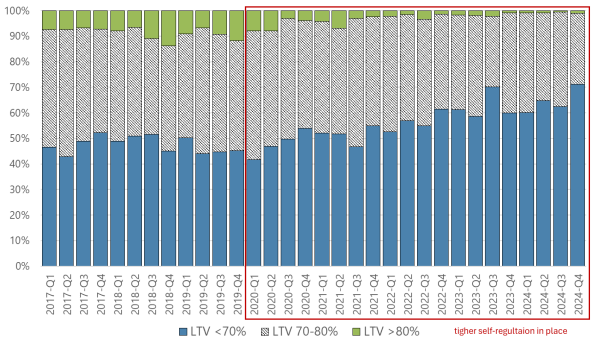
D. LTVs for Buy-to-Let by Corporates
(percent, debt-weighted av. for new lending and refinancing)



E. LTV Ratios for New Mortgages for Household Owner-Occupied Real Estate
(percent of total new owner-occupied mortgage lending)



F. LTV Ratios for New Mortgages for Household Income-Producing Real Estate
(percent of total new income-producing mortgage lending)

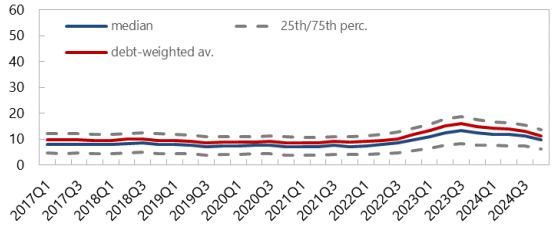


Sources: SNB, FINMA, and IMF staff calculations.

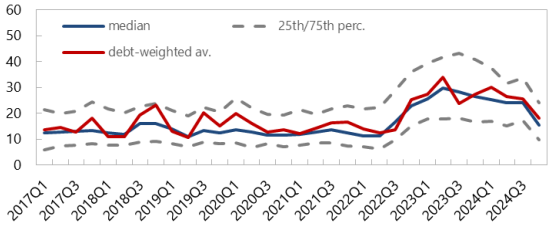
Note: The data shown here were sourced from the HypoB dataset, which is a survey comprising 29 Swiss banks, the ones with the most material mortgage lending exposures. The data pertain to newly granted and refinanced mortgages, per quarter, covering the 2017Q1-2024Q4 period.

Appendix I. Figure 5. Switzerland: Debt Service to Income (DSTI) Ratios for New Mortgage Lending

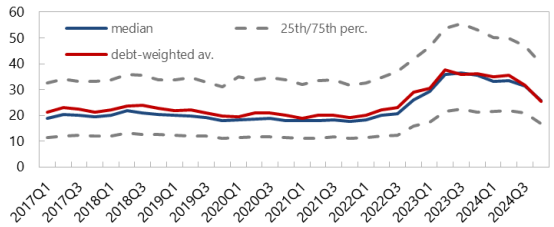
A. DSTIs for Owner-Occupied Housing
(percent, debt-weighted av. for new lending and refinancing)



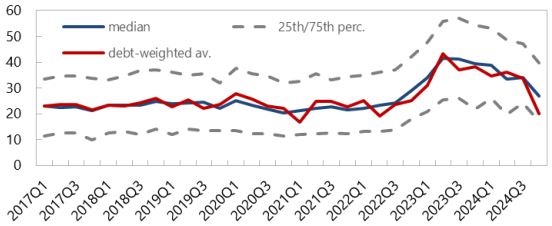
B. DSTIs for Commercial Real Estate
(percent, debt-weighted av. for new lending and refinancing)



C. DSTIs for Buy-to-Let by Households
(percent, debt-weighted av. for new lending and refinancing)



D. DSTIs for Buy-to-Let by Corporates
(percent, debt-weighted av. for new lending and refinancing)

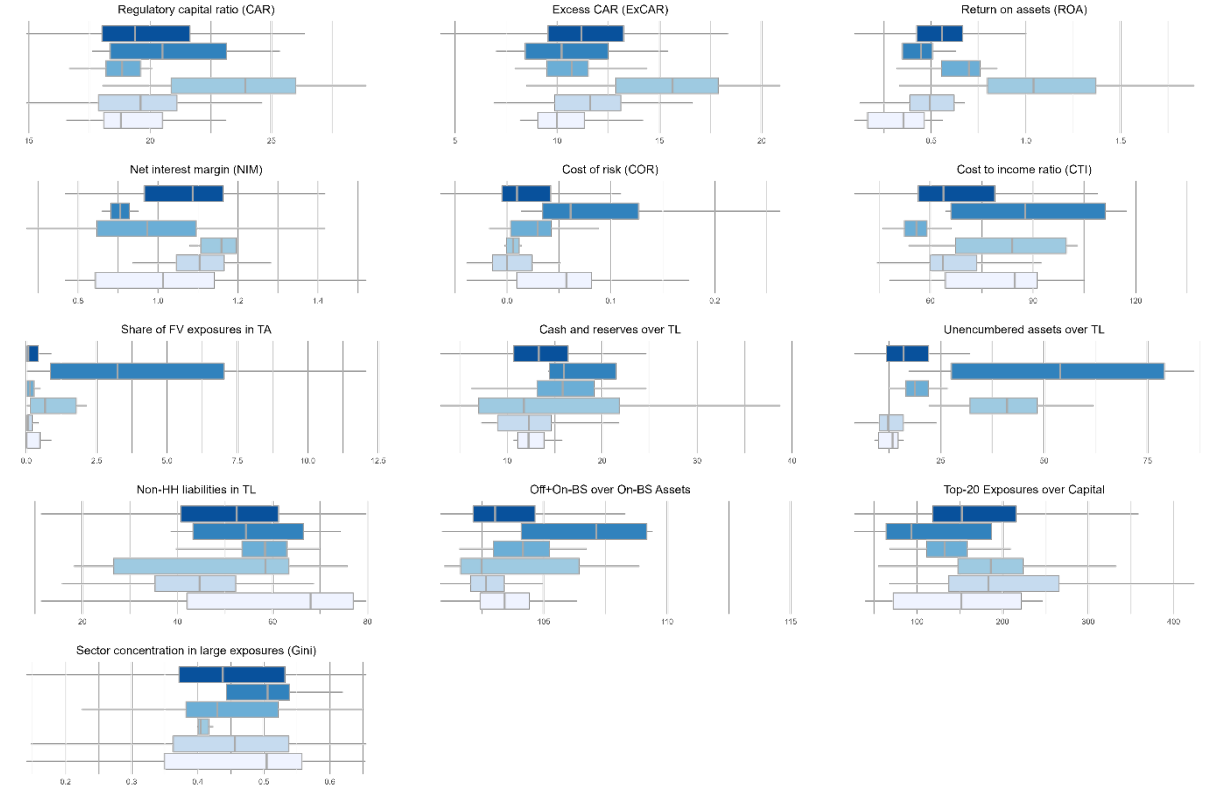


Sources: SNB, FINMA, and IMF staff calculations.

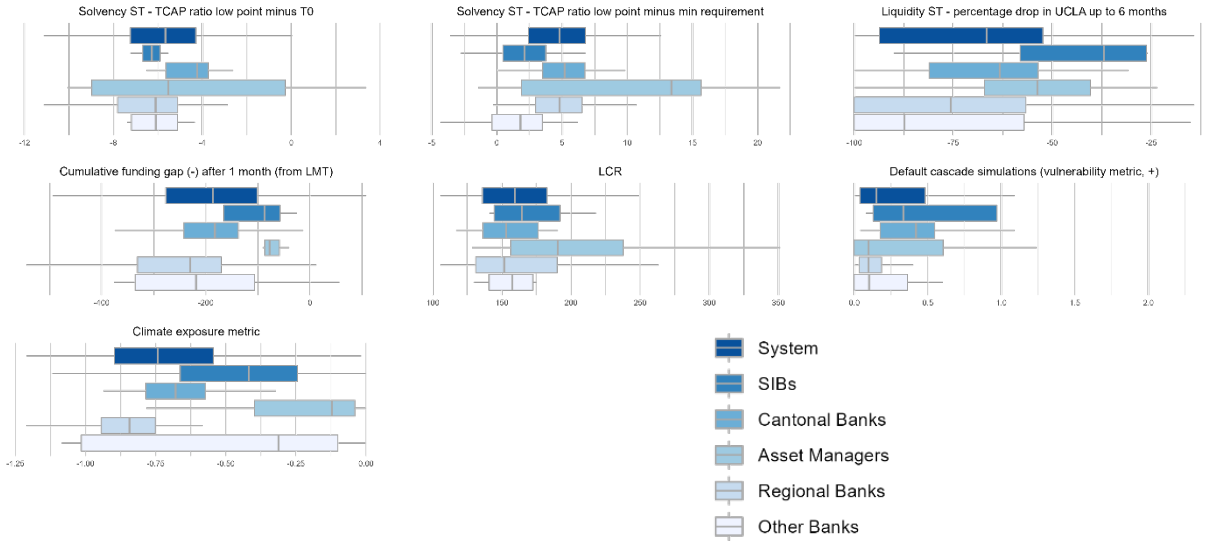
Note: The data shown here were sourced from the HypoB dataset, which is a survey comprising 29 Swiss banks, the ones with the most material mortgage lending exposures. The data pertain to newly granted and refinanced mortgages, per quarter, covering the 2017Q1-2024Q4 period.

Appendix I. Figure 6. Switzerland: Holistic Vulnerability Analysis for Banks—Data for all 20 Indicators

Initial Conditions



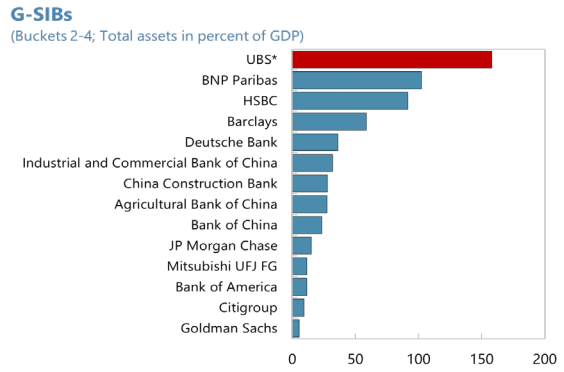
Forward-Looking Vulnerability Analysis



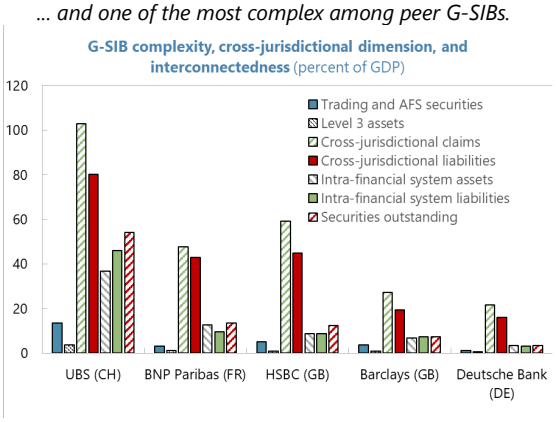
Sources: SNB, FINMA, and IMF staff models and calculations.
Note: The charts show the 20 indicators involved in the holistic vulnerability analysis. Shown are the distributions of the underlying raw data for banks, i.e., not the resulting ranks per indicator.

Appendix I. Figure 7. Switzerland: G-SIBs and D-SIBs

UBS is now the world's largest G-SIB, by assets to GDP ...



... and one of the most complex among peer G-SIBs.



Sources: Haver Analytics; SNB; BIS, Eurostat; and IMF staff calculations; FSB Dashboard for G-SIBs.
Note: * Estimated size post-acquisition of Credit Suisse.

Appendix I. Table 1. Switzerland: Selected Economic Indicators, 2018–2029

(In percent, unless otherwise indicated)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
						Est.			Projections			
Real GDP (percent change)	2.9	1.2	-2.3	5.6	3.1	0.7	1.3	1.3	1.8	1.2	1.8	1.2
Total domestic demand	1.2	2.0	-0.4	0.2	2.1	2.0	-0.2	1.4	1.2	1.2	1.2	1.2
Final domestic demand	0.7	1.1	-1.9	2.5	2.3	1.1	0.6	1.4	1.2	1.2	1.2	1.2
Private consumption	0.7	1.2	-3.4	2.2	4.3	1.5	1.3	1.1	1.1	1.1	1.1	1.1
Public consumption	0.8	0.8	3.8	3.0	-1.2	1.7	1.5	1.0	1.0	1.0	1.0	1.0
Gross fixed investment	0.8	0.9	-1.4	2.8	0.0	0.1	-1.3	2.0	1.5	1.5	1.5	1.5
Construction	0.0	-0.9	-1.0	-3.1	-6.9	-2.7	0.7	1.5	0.8	0.8	0.8	0.8
Machinery and Equipment	1.2	1.8	-1.7	6.0	3.4	1.4	-2.1	2.2	1.9	1.9	1.9	1.9
Inventory accumulation 1/	0.4	0.8	1.4	-2.0	-0.2	0.7	-0.8	0.0	0.0	0.0	0.0	0.0
Foreign balance 1/	1.8	-0.6	-2.0	5.4	1.3	-0.9	1.5	0.2	0.8	0.2	0.8	0.2
Foreign balance without sporting events	0.3	-0.6	0.0	5.4	0.1	1.1	0.0	1.0	2.0	3.0	4.0	5.0
Exports	3.3	-0.7	-5.6	13.6	6.4	0.8	2.2	1.8	4.2	3.4	4.2	3.4
Imports	0.7	0.3	-3.2	5.9	5.6	2.8	0.0	2.0	4.0	4.0	4.0	4.0
Nominal GDP (billions of Swiss francs)	709.9	717.3	696.1	744.5	791.0	804.0	825.0	844.5	868.4	887.6	912.9	933.0
Savings and investment (percent of GDP)												
Gross national saving	31.3	30.5	30.1	33.2	34.2	32.4	32.5	32.0	32.5	32.4	33.0	33.0
Gross domestic investment	25.7	26.4	29.6	26.4	24.8	25.9	24.3	24.4	24.5	24.9	25.0	25.4
Current account balance	5.6	4.1	0.5	6.8	9.4	6.5	8.2	7.6	8.0	7.6	8.0	7.6
Prices and incomes (percent change)												
GDP deflator	0.8	-0.1	-0.7	1.3	3.0	0.9	1.3	1.0	1.0	1.0	1.0	1.0
Consumer price index (average)	0.9	0.4	-0.7	0.6	2.8	2.1	1.3	1.0	1.0	1.0	1.0	1.0
Consumer price index (end period)	0.7	0.2	-0.8	1.6	2.9	1.7	1.2	1.0	1.0	1.0	1.0	1.0
Nominal wage growth	0.5	0.8	0.9	-0.2	0.9	1.7	1.5	1.3	1.0	1.0	1.0	1.0
Unit labor costs (total economy)	-0.7	1.8	1.1	-1.3	2.3	2.7	1.0	0.2	0.1	0.2	0.2	0.2
Employment and slack measures												
Employment (percent change)	1.0	0.7	-0.5	0.6	1.5	2.2	0.6	0.5	0.6	0.7	0.7	0.7
Unemployment rate (in percent)	2.5	2.3	3.2	3.0	2.2	2.0	2.4	2.5	2.5	2.5	2.5	2.5
Output gap (in percent of potential)	0.7	0.4	-1.6	-0.4	0.5	0.0	-0.3	-0.2	-0.1	0.0	0.0	0.0
Capacity utilization	73.8	74.6	71.8	76.6	77.9	77.5	...	...	...	...	...	...
Potential output growth	1.8	1.8	-0.3	4.0	2.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5
General government finances (percent of GDP)												
Revenue	33.0	33.3	34.0	34.1	32.7	32.1	32.1	32.0	32.0	32.0	32.0	32.0
Expenditure	31.7	32.0	37.0	34.4	31.6	32.0	31.6	31.7	31.8	31.8	31.8	31.8
Balance	1.3	1.3	-3.0	-0.3	1.2	0.2	0.6	0.3	0.2	0.2	0.2	0.2
Cyclically adjusted fiscal balance	1.0	1.2	-2.5	-0.2	1.0	0.2	0.7	0.4	0.2	0.2	0.2	0.2
Gross debt 2/	39.8	39.6	43.2	41.0	37.2	33.3	31.9	30.8	29.8	29.0	28.0	27.3
Monetary and credit (percent change, averages)												
Broad money (M3)	3.2	0.8	6.5	1.4	0.1	-2.0	2.6	2.4	2.8	2.2	2.9	2.2
Domestic credit, non-financial	4.0	4.2	2.4	3.8	2.6	1.8	2.6	2.4	2.8	2.2	2.9	2.2
Three-month SFr LIBOR	-0.7	-0.7	-0.7	-0.8	n.a.	1.8	...	...	...	...	...	...
Yield on government bonds (7-year)	-0.2	-0.7	-0.6	-0.4	0.6	1.0	...	...	...	...	...	...
Exchange rates (levels)												
Swiss francs per U.S. dollar (annual average)	1.0	1.0	0.9	0.9	1.0	0.9	...	...	...	...	...	...
Swiss francs per euro (annual average)	1.2	1.1	1.1	1.1	1.0	1.0	...	...	...	...	...	...
Nominal effective rate (avg., 2010=100)	120.4	123.2	130.2	129.9	135.9	144.5	...	...	...	...	...	...
Real effective rate (avg., 2010=100) 3/	103.2	104.2	108.2	105.5	105.8	109.3	...	...	...	...	...	...

Sources: Haver Analytics; IMF's Information Notice System; Swiss National Bank; and IMF Staff estimates.
1/ Contribution to growth. Inventory accumulation includes statistical discrepancies and net acquisitions.
2/ Reflects new GFSM 2001 methodology, which values debt at market prices.
3/ Based on relative consumer prices.

Appendix II. Risk Assessment Matrix

Appendix II. Table 1. Switzerland: Risk Assessment Matrix 1/

Sources of risk	Likelihood	Expected impact upon materialization
Conjunctural Risks		
Trade policy and investment shocks. Higher trade barriers or sanctions reduce external trade, disrupt FDI and supply chains, and trigger further U.S. dollar appreciation, tighter financial conditions, and higher inflation.	**High**	These three risks, in conjunction, form the starting point for the supply shock oriented adverse scenario for the Switzerland FSAP. A material supply shock, if it were to materialize, would trigger inflation pressure particularly at global level, the risk of de-anchoring inflation expectations, and therefore the tendency for policy response to increase interest rates. This would pressure Swiss banks' funding costs and therefore their net income, because the long-duration real estate lending is dominant in size and mostly at fixed rate terms. The nonfinancial corporate sector may suffer from diminished export-based income, alongside rising bank borrowing costs for the affected firms, thereby leading to rising corporate defaults and associated loan losses for banks.
Deepening geoeconomic fragmentation. Persistent conflicts, inward-oriented policies, protectionism, weaker international cooperation, labor mobility curbs, and fracturing technological and payments systems lead to higher input costs, hinder green transition, and lower trade and potential growth.		
Regional conflicts. Intensification of conflicts (e.g., in the Middle East, Ukraine, Sahel, and East Africa) or terrorism disrupt trade in energy and food, tourism, supply chains, remittances, FDI and financial flows, payment systems, and increase refugee flows.	**Medium**	
Sharp correction in the real estate market. The imbalances, especially in residential real estate, continue, as house prices remain high. While there has been some moderation in house prices, in response to higher interest rates, a steep increase in interest rates, along with other negative shocks (e.g., lower growth, higher living costs, cross-border linkages), could trigger declines in housing prices.	**Medium**	The Swiss financial system has a very large exposure to the real estate market. An abrupt correction in real estate prices could potentially lead to asset quality deterioration for banks, lower returns or losses for investors, shrinking wealth for households, and a contraction in construction and other related activities, posing risks to economic and financial sector stability.
Structural Risks		
Risks stemming from the ongoing UBS takeover of Credit Suisse and the very large G-SIB. Although so far successful, execution risks remain significant until the consolidation of operations is completed. The large size of the G-SIB poses risks during stress periods.	**Medium**	The very elevated size of the larger G-SIB implies substantial concentration concerns, both in terms of connectedness/centrality as well as regarding competition/concentration in the Swiss banking system. This may have adverse consequences for the solvency position of the remainder of the Swiss banking system.

Appendix II Table 1. Switzerland: Risk Assessment Matrix (Concluded)

Sources of risk	Likelihood	Expected impact on financial stability when realized
Cyberthreats. Cyberattacks on physical or digital infrastructure and service providers (including digital currency and crypto assets) or misuse of AI technologies trigger financial and economic instability.	**High**	Switzerland is a leader in cross-border asset management and fintech, prone to cyberattacks. Successful attacks can lead to outages of information and communication technology systems and jeopardize the goals of availability, confidentiality, and integrity, compromising the attractiveness of the financial system.
Systemic financial instability. Financial sector instability in major Swiss banks' counterparts and political uncertainty (e.g., from elections) trigger market dislocations, with cross-border spillovers affecting weak banks and NBFIs.	**Medium**	Switzerland is a global financial center. In the event of a severe financial crisis in major jurisdictions to which the Swiss banking system is exposed, Swiss banks could face adverse spillover effects, including through materializing credit risk, rising funding costs, and liquidity risk events.
Extreme climate events. Extreme climate events driven by rising temperatures cause loss of human lives, severe damage to infrastructure, supply disruptions, lower growth, and financial instability.	**Medium**	Switzerland is affected by climate change. Related extreme events have become more frequent over the past century, often causing significant economic losses. Such developments also bring challenges to insurance and reinsurance companies.

1/ The Risk Assessment Matrix (RAM) shows events that could materially alter the baseline path. The relative likelihood is the staff's subjective assessment of the risks surrounding the baseline (with respective probabilities as "low" = below 10, "medium" = 10–30, and "high" = 30–50 percent) in the next 1–3 years.

Appendix III. Macro-Financial Scenarios

Appendix III. Table 1. Switzerland: Macro-Financial Scenarios

#	Variable		2024	Baseline			Adverse (D)			Adverse (S)		
				2025	2026	2027	2025	2026	2027	2025	2026	2027
1	Real GDP	Level (a.f., 2024=100)	100	101.2	103.1	104.6	97.5	97.5	101.5	98.8	98.5	99.3
		YoY in %	1.3	1.2	1.9	1.4	-2.5	-0.1	4.1	-1.2	-0.2	0.8
2	GDP Deflator	Level (a.av., 2024=100)	100	100.3	101.1	101.8	101.3	99.2	97.5	104.1	104.8	103.1
		YoY in %	1.3	0.3	0.7	0.7	1.3	-2.0	-1.7	4.1	0.6	-1.7
3	Nominal GDP	Level (a.f., 2024=100)	100	101.6	104.2	106.4	98.8	96.7	98.9	102.8	103.3	102.3
		YoY in %	2.6	1.6	2.6	2.1	-1.2	-2.1	2.3	2.8	0.4	-0.9
4	CPI	Level (a.av., 2024=100)	100	100.3	101.1	101.8	99.5	99.8	100.5	103.2	106.1	107.7
		YoY in %	1.0	0.3	0.7	0.7	-0.5	0.3	0.7	3.2	2.8	1.5
5	Core CPI	Level (a.av., 2024=100)	100	100.3	101.1	101.8	99.5	99.8	100.5	103.2	106.1	107.7
		YoY in %	1.0	0.3	0.7	0.7	-0.5	0.3	0.7	3.2	2.8	1.5
6	Unemployment Rate	Level (a.av.) in %	2.5	2.7	2.6	2.7	3.6	4.0	3.6	3.2	3.8	3.9
		Abs. YoY change in p.p.	0.4	0.2	-0.1	0.1	1.2	0.4	-0.4	0.8	0.6	0.2
7	Wages: Nominal	Level (a.f., 2024=100)	100	101.8	104.3	106.6	99.9	101.1	104.2	103.4	107.0	110.1
		YoY in %	2.8	1.8	2.5	2.2	-0.1	1.2	3.1	3.4	3.5	2.9
8	Wages: Real	Level (a.f., 2024=100)	100	101.5	103.2	104.8	100.4	101.3	103.7	100.2	100.8	102.3
		YoY in %	1.5	1.5	1.7	1.5	0.4	0.9	2.4	0.2	0.7	1.4
9	Interest Rates Switzerland	Short-term (a.av.) in %	1.1	0.3	0.3	0.3	-0.2	0.1	0.3	2.2	2.2	2.0
		Long-term (a.av.) in %	0.6	0.8	0.8	0.9	1.2	1.1	0.9	3.6	4.5	2.3
		Term spread (a.av.) in p.p.	-0.4	0.5	0.5	0.6	1.5	0.9	0.6	1.4	2.3	0.3
10	Effective CHF: Nominal	Level (a.av., 2024=100)	100	100.3	101.1	101.8	105.2	105.3	104.1	109.1	107.9	105.2
		YoY in %	2.8	0.3	0.7	0.7	5.2	0.1	-1.1	9.1	-1.1	-2.5
11	Effective CHF: Real	Level (a.av., 2024=100)	100	100.0	100.0	100.0	105.7	105.5	103.6	105.7	101.7	97.7
		YoY in %	1.5	0.0	0.0	0.0	5.7	-0.2	-1.8	5.7	-3.8	-3.9
12	Residential Property Prices: Nominal	Level (a.av., 2024=100)	100	100.3	101.1	101.8	69.4	68.3	77.9	84.6	83.9	89.7
		YoY in %	1.4	0.3	0.7	0.7	-30.6	-1.5	14.1	-15.4	-0.8	6.9
13	Residential Property Prices: Real	Level (a.av., 2024=100)	100	100.0	100.0	100.0	69.8	68.5	77.6	81.9	79.1	83.3
		YoY in %	0.2	0.0	0.0	0.0	-30.2	-1.8	13.3	-18.1	-3.5	5.3
14	Commercial Property Prices: Nominal	Level (a.av., 2024=100)	100	100.3	101.1	101.8	69.1	63.8	75.5	76.0	74.5	86.6
		YoY in %	0.2	0.3	0.7	0.7	-30.9	-7.6	18.3	-24.0	-2.0	16.2
15	Commercial Property Prices: Real	Level (a.av., 2024=100)	100	100.0	100.0	100.0	69.4	64.0	75.2	73.6	70.2	80.4
		YoY in %	-1.0	0.0	0.0	0.0	-30.6	-7.9	17.5	-26.4	-4.6	14.5
16	Stock Prices: Nominal	Level (a.av., 2024=100)	100	100.3	101.1	101.8	53.8	62.1	84.3	64.1	62.7	74.1
		YoY in %	6.3	0.3	0.7	0.7	-46.2	15.4	35.8	-35.9	-2.1	18.1
17	Stock Prices: Real	Level (a.av., 2024=100)	100	100.0	100.0	100.0	54.0	62.1	83.9	62.3	59.1	68.8
		YoY in %	5.0	0.0	0.0	0.0	-46.0	15.1	35.0	-37.7	-5.1	16.4
18	Private Sector Credit: Nominal	Level (e.o.p, end-2024=100)	100	100.3	101.1	101.8	96.7	100.3	102.9	104.8	103.6	102.9
		YoY in %	2.5	0.3	0.7	0.7	-3.3	3.8	2.6	4.8	-1.1	-0.7
19	Private Sector Credit: Real	Level (a.av., 2024=100)	100	100.0	100.0	100.0	97.2	100.6	102.4	101.5	97.6	95.6
		YoY in %	1.0	0.0	0.0	0.0	-2.8	3.5	1.9	1.5	-3.8	-2.1
20	Global Commodity Prices	Level (a.av., 2024=100)	100	94.8	94.8	95.1	84.1	76.2	84.2	107.6	109.7	108.0
		YoY in %	-5.1	-5.2	0.0	0.4	-15.9	-9.5	10.6	7.6	2.0	-1.6
21	Oil Price (Brent Crude)	Level (a.av.) in U.S. Dollar	79.6	78.1	75.0	71.9	53.5	36.9	46.5	96.0	92.6	82.6
		YoY in %	-2.8	-1.8	-4.1	-4.1	-32.8	-31.0	25.9	20.6	-3.5	-10.9

Sources: World Economic Outlook (WEO) and IMF staff calculations.

Notes: a. f. = annual flow, a. av. = annual average, e.o.p. = end of period. Adverse (D) denotes the demand shock scenario. Adverse (S) denotes the supply shock scenario.

Appendix III. Table 2. Switzerland: Macro-Financial Scenarios—Market Risk Component

			Adverse (D)	Adverse (S)
Equity prices (shocks in %)	Switzerland		-50	-45
	France		-50	-45
	Germany		-40	-35
	Italy		-50	-45
	Netherlands		-40	-35
	Spain		-50	-45
	UK		-50	-45
	US		-40	-35
	Japan		-40	-35
	Other Advanced Economies (AE)		-45	-40
	Other Non-AE Rest of the World		-55	-50
Short-term interest rates (1Y) (shocks in bps)	Switzerland		-35	130
	France		-25	150
	Germany		-50	100
	Italy		-10	400
	Netherlands		-50	165
	Spain		-15	270
	UK		-20	195
	US		-40	165
	Japan		-30	130
	Other Advanced Economies (AE)		-30	200
	Other Non-AE Rest of the World		-20	300
Long-term interest rates (10Y) (shocks in bps)	Switzerland		120	300
	France		170	220
	Germany		100	200
	Italy		315	450
	Netherlands		170	200
	Spain		270	370
	UK		200	350
	US		190	230
	Japan		145	200
	Other Advanced Economies (AE)		200	300
	Other Non-AE Rest of the World		250	400
Real estate prices (shocks in %)	Residential property	Switzerland	-35	-25
		Euro area	-30	-20
		UK	-35	-25
		US	-35	-25
		Rest of the world	-40	-30
	Commercial property	Switzerland	-40	-30
		Euro area	-35	-25
		UK	-40	-30
		US	-40	-30
		Rest of the world	-45	-35
Foreign exchange rates (shocks in %)	USD-CHF		-20	-15
	EUR-CHF		-20	-15
	GBP-CHF		-30	-20
	JPY-CHF		-20	-15
Other	Brent crude oil (USD) shock in %		-50	75
	Other commodities, shock in %		-25	25

Sources: IMF staff calculations.

Notes: Adverse (D) denotes the demand shock scenario. Adverse (S) denotes the supply shock scenario.

Appendix III. Table 3. Switzerland: Macro-Financial Scenarios—Market Risk Component II

Corporate Bond Spreads		Adverse (D)		Adverse (S)	
		Nonfinancial	Financial	Nonfinancial	Financial
Switzerland	AAA	70	75	60	65
	AA	110	115	100	110
	A	275	245	240	230
	BBB	310	290	280	270
	BB	465	435	420	405
	B and <B	560	520	505	485
	Unrated	350	330	320	310
Euro area	AAA	95	90	85	70
	AA	110	105	95	90
	A	260	240	230	220
	BBB	300	265	250	240
	BB	450	400	375	350
	B and <B	540	480	430	420
	Unrated	340	300	280	270
United Kingdom	AAA	55	120	45	100
	AA	100	140	95	115
	A	270	300	230	280
	BBB	300	350	250	300
	BB	450	525	375	450
	B and <B	540	630	450	540
	Unrated	340	400	280	340
United States	AAA	80	60	60	40
	AA	150	130	140	120
	A	400	300	350	280
	BBB	450	360	400	350
	BB	675	540	600	525
	B and <B	810	650	720	630
	Unrated	500	400	450	390
Japan	AAA	45	35	35	30
	AA	70	65	60	55
	A	170	150	145	140
	BBB	190	180	165	160
	BB	280	270	250	240
	B and <B	340	320	300	290
	Unrated	220	200	190	180
Other Advanced Economies (AEs)	AAA	80	90	60	70
	AA	110	130	100	115
	A	275	300	240	280
	BBB	310	350	280	300
	BB	465	525	420	450
	B and <B	560	630	500	540
	Unrated	350	400	315	340
Other Non-AE Rest of the World	AAA	90	115	80	95
	AA	140	145	120	135
	A	310	375	290	330
	BBB	360	425	340	380
	BB	630	640	510	570
	B and <B	650	770	510	680
	Unrated	410	480	380	430

Sources: IMF staff calculations.

Notes: Adverse (D) denotes the demand shock scenario. Adverse (S) denotes the supply shock scenario.

Appendix III. Table 4. Switzerland: Adverse Scenario Specification Specifically for the Insurance Sector

			Change in percent	Change in basis points
Equity	Equity, domestic		-45.0%	
	Other advanced economies		-40.0%	
	Emerging and developing economies		-50.0%	
Property	Domestic	Residential	-25%	
		Commercial	-30%	
	Foreign	Residential	-30%	
		Commercial	-35%	
Corporate bond spreads	Non-Financials, Structured Finance and Financials (in parentheses)	AAA		60 (65)
		AA		100 (120)
		A		240 (270)
		BBB, unrated		290 (330)
		BB		440 (490)
		B and lower		510 (570)
Sovereign bond spreads	Switzerland			30
	Highly rated EEA countries (AA and above)			100
	United Kingdom			95
	United States			65
	Japan			30
	Other EEA countries			200
	Other advanced economies			100
	Emerging and developing economies			200
	Supranationals			0
Mortgage and loan default rates				150
Appreciation of CHF against	EUR, USD, JPY		15%	
	GBP		20%	
Risk-free interest rates	Short-term (up to one year)	CHF		107
		EUR		328
		USD		478
		GBP		479
	Long-term (10 years+)	CHF		337
		EUR		258
		USD		502
		GBP		501

Source: IMF Staff

Appendix IV. Stress Test Matrices

Appendix IV. Table 1. Switzerland: Banking Sector Solvency Stress Test

Domain		Description
1. Institutional perimeter	Institutions included	• 92 (112) banks at consolidated (solo) level will be in-scope, including the four SIBs, all cantonal banks, and various universal commercial banks and private banks (asset and wealth management banks)
	Market share	• 93 percent of banking system assets at end-2024
	Data sources and cut-off date	• Public and supervisory data • Cut-off date: end-December 2024 • Consolidated banking groups, including their foreign exposures where material (>5 percent of a bank's total assets)
2. Methodology	Framework	• Balance sheet model that accounts for all relevant risk drivers: credit risk, interest rate and market risk, other P&L components, RWA • Dynamic balance sheet • Combination of structural and econometric model components
	Model components	• Credit risk: structural model (micro-macro simulation model, the IDHBS+ model) for household mortgage portfolios, for both PD and LGD components, rooted in micro/household survey data; econometric satellite models for nonfinancial corporate portfolios; satellite models based on Moody's KMV PDs for financial corporate portfolios, using BMA methodology • Interest income and expense: econometric pass-through equations, capturing all structural dependences of bank rates on market rates, policy rates, market price of risk, possible feedback from solvency to cost of funding, etc. • Net fees and commission income and other income/expenses: bank panel econometric models, using BMA methodology • Market risk: modified duration approach for bond valuation; partial account for hedging • STA risk weights constant • IRB risk weights modeled dynamically using the relevant risk parameter inputs, themselves projected via structural or econometric model components
	Stress test horizon	• 3 years: 2025-2027
3. Type of analyses	Scenario analysis	• Baseline scenario, based on latest IMF WEO • Two adverse scenarios: (1) demand shock-dominated, disinflationary scenario with falling base interest rates; (2) supply shock-dominated, inflationary scenario with initially rising interest rates • Informed by (G)RAM
	Sensitivity analysis	• Mark-to-market for HTM bonds, in T0 and then revaluing them in line with the interest rate trajectories in the macrofinancial scenarios • Solvency to funding cost feedback on vs. off
4. Regulatory and accounting standards		• Accounting and regulatory standards as relevant for banks in Switzerland (in particular Swiss GAAP), in particular for what concerns expected credit loss provisioning • Expected credit loss provisioning principles, including provisioning for performing exposures, accounted for in the stress test model
5. Capital buffers and hurdle rates		• Minimum capital requirements (Pillar 1) plus prudential buffers (Pillar 2), CCoB, CCyB, SIB surcharges and others, as relevant • Under the adverse scenarios, CCoB and CCyB are allowed to be "consumed"; capital shortfalls are examined with and without these buffer requirements, to inform how many banks would fall into such buffer ranges
6. Reporting of results		• System-wide capital evolution/depletion and capital shortfalls • Aggregated contributions to evolution of capital ratios • All by clusters of banks, ensuring that no individual institutions and their results can be inferred

Appendix IV. Table 2. Switzerland: Banking Sector Liquidity Stress Test		
Domain		**Description**
1. Institutional perimeter	Institutions	• Same as for solvency stress test (see Table D1)
	Market share	• Same as for solvency stress test (see Table D1)
	Data and base date	• Regulatory data based on Basel III standardized liquidity monitoring tools • Cut-off date: end-December 2024.
2. Channels of risk propagation	Methodology	• Cash flow-based liquidity stress test, with account for liquidity-solvency feedback and add-back mechanism pertaining to secured funding • Link to market risk, by involving equity and bond revaluation in the liquidity stress test model • Additional monitoring metrics: o Liquidity coverage ratio (LCR) in CHF (requirement), and in significant currencies (EUR, GBP, JPY, USD) (monitoring metric) o Net Stable Funding Ratio (reporting requirement) o Concentration of funding (monitoring metric)
3. Risks and buffers	Risks	• Funding risk, rollover risk, market liquidity risk
	Buffers	• Stock of liquid assets
4. Tail shocks	Size of the shock	• Runoff shock calibration for the cash flow-based liquidity stress test informed by LCR parameterization and historical experience in Switzerland and other jurisdictions • Revaluation of bond holdings that form part of the counterbalancing capacity in line with market risk shocks that are relevant for the solvency stress test
5. Regulatory standards	Regulatory standards	• Basel III full implementation for the LCR ratio at 100 percent. • Counterbalancing capacity above net cash outflows under stress scenario.
6. Reporting format for results	Output presentation	• Changes in average liquidity position and counterbalancing capacity by scenario. • Distribution of banks' liquidity position by scenario. • Number of banks with counterbalancing capacity below net cash outflows. • Banks' post-shock net liquidity position. • Liquidity shortfall in terms of banking system total liabilities.

Appendix IV. Table 3. Switzerland: Insurance Sector Solvency Stress Test

Domain		Framework	
		BU by insurers	TD by IMF
1. Institutional Perimeter	Institutions included	• Six insurance groups covering two thirds of domestic life and non-life premia	
	Data	• Companies own data • FINMA regulatory reporting	• Companies own data • FINMA regulatory reporting
	Reference date	• Regulatory reporting December 31, 2024 • December 31, 2023 for sensitivity analysis (cyber)	• December 31, 2024
2. Channels of Risk Propagation	Methodology	• Investment assets: market value changes after price shocks affecting the solvency position. • Sensitivity analysis: effect on available capital and solvency position.	• Investment assets: market value changes after price shocks, affecting the value of assets and liabilities
	Time horizon	• Instantaneous shock • 3-year projection	• Instantaneous shock
3. Tail shocks	Scenario analysis	• Macro-financial scenario broadly in line with the banking sector stress test • Adverse scenario: ○ Risk-free interest rates 107 bps (1y CHF), 337 bps (10y CHF), 328 bps (1y EUR), 258 bps (10y EUR), 478 bps (1y USD), 502 bps (10y USD), 479 bps (1y GBP), 501 bps (10y GBP) ○ Sovereign bond spreads 30 bps domestic, 100 bps low spread EEA countries, 200 bps other EEA countries, 95bp United Kingdom, 65bp United States, 30bp Japan, 100 bps other advanced economies, 200 bps emerging and developing countries. ○ Stock prices -45 percent domestic, 40 percent other advanced economies, 50 percent emerging and developing economies. ○ Domestic property prices between -25 percent (residential) and -30 percent (commercial), foreign property prices between -30 percent (residential) and -35 percent (commercial)	

Appendix IV. Table 3. Switzerland: Insurance Sector Solvency Stress Test (Concluded)			
		○ Corporate bond spreads between 65 bps (AAA financials) and 570 bps (B and lower financials), and between 60 bps (AAA non-financials) and 510 bps (B and lower non-financials) ○ Mortgage default spread increase by 150 basis points ○ Appreciation of CHF against major currencies (EUR, USD, JPY: 15%, GBP: 20%)	
4. Tail shocks	Sensitivity analysis	• Outage of cloud service provider • Petya/WannaCry-type ransomware attack	• None
5. Regulatory standards and parameters	Regulatory/accounting standards	• Swiss Solvency Test • National GAAP, IFRS, US GAAP	
6. Reporting Format for Results	Output presentation	• Impact on solvency ratios • Contribution of individual shocks. • Impact of reactive management actions. • Dispersion measures of solvency ratios.	• Impact on assets over liabilities • Contribution of individual shocks • Dispersion measures of assets over liabilities

Appendix IV. Table 4. Switzerland: Interconnectedness Analysis	
Domain	**Description**
Institutions involved	• Swiss banks • Switzerland and other countries (BIS data) to which Switzerland is exposed through banking system asset-side claims and liability-side borrowings
Data and starting position	• Swiss domestic sectoral exposures • BIS cross-country exposures, alongside additional data for assets, risk weighted assets, and capital, across countries • Swiss banks' bilateral interbank exposure data (largest cross-exposures) • SWIFT cross-country transaction flow data
Methodology	• Domestic cross-sectoral exposure analysis (net lenders, net borrowers) • Network metrics • Default contagion simulations, using the Espinosa-Vega & Solé (EVS 2010) model, based on BIS cross-country exposure data and Swiss banks' interbank exposure data • Systematic shock simulations (each node fails one after another), and inform triggers by result of solvency/liquidity stress test • Analysis and visualization of SWIFT transaction flow data (not as input for EVS models)
Buffers	• Banks' capital and liquid asset buffers
Output, results	• Network metrics and visualizations • EVS model results: bank and country level impact and vulnerability rankings, capital losses. • Emphasis placed on entities (banks) ranking high in terms of both impact and vulnerability

Appendix IV. Table 5. Switzerland: Climate Risk Analysis

Domain	Description
1. Institutions included	• Same as in the banking sector stress testing, covering mortgage portfolios (depending on the availability of SNB data on geographical distribution)
2. Data and starting position	• Public and supervisory • Cut-off date: December 2024 • Public or authorities' data on climate projections and insurance conditions
3. Methodology	• Structural model (micro-macro simulation model) for household mortgage portfolios, for both PD and LGD components, rooted in micro/household survey data, geographically differentiated, linked to climate projections, and considering insurance conditions
4. Scenarios	• Baseline scenario, same as in the banking sector stress testing (current climate conditions) • At least one adverse scenario, based on future climate conditions from IPCC (depending on the availability of AR5 or AR6 and heterogeneity of future climate conditions)
5. Time horizon	• 3 years: 2025-2027, and considering future climate conditions for 2050 and 2100
6. Risks/factors assessed	• The impact of chronic and acute climate conditions on households and its effects on PD and LGD components
7. Output presentation	• Delta PDs and delta LGDs • Individual banks' capital ratio impacts

Appendix V. Bank Credit Risk Model Details (For Segments Other Than Residential Real Estate)

1. A Bayesian Model Averaging (BMA) methodology was employed to estimate the corporate PD models. The methodology is designed to explicitly account for model uncertainty, and optionally involves coefficient sign constraints.[47] It does so by considering a large number of possible models for a given left hand-side model variable, considering all combinations of a set of potential predictor variables from a predictor pool. The left hand-side variables are the sectoral PDs sourced from Moody's Credit Edge (1-year expected default frequencies, EDFs). Four sub-segments were defined: NFC (307 Swiss firms), CRE (30 firms), banks (32 firms), and NBFIs (63 firms) (Figure E1).

2. Sign constraints were imposed on the long-run multipliers of the predictors. This is useful to obtain models that have economically meaningful coefficient signs (regarding their long run multipliers) and result in meaningful scenario conditional forecasts. Table E1 shows the inclusion settings and sign constraints. GDP growth, the unemployment rate, and interest rates were all allowed to enter the models from the four segments. Residential property prices were allowed to enter the models for the CRE and bank segment (relevant in the latter context is the LGD channel, for Swiss banks' sizeable mortgage portfolios). Leverage was allowed to drive the PDs in the four sub-segments, using their respective own leverage metrics. Additional scenario paths had to be designed for those (Figure E2).

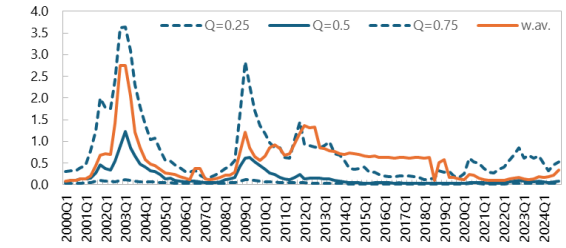
3. The pandemic period was excluded from the estimation for all models; its inclusion would bias the macro-financial sensitivities toward zero. This is because PDs did not react that adversely during the pandemic due to significant policy support, while macro-financial conditions momentarily deteriorated materially. The maximum number of right hand-side variables per equation in the model space was set to 5; beyond the time contemporaneous inclusion of the predictors, two additional lags were allowed (optimized per equation); a logit transformation of the PDs was considered for the left hand-side of the models, to guarantee that the projected PDs do not leave the 0-1 interval.

4. For the NFC segment, different models were explored, considering debt weighted vs. median PDs and including vs. excluding the stock price variable. The latter was—when allowed to enter the models—quite dominant a driver, and its severe drop in the adverse scenario making the NFC PDs move up very materially. Shown below are the model structures (Figure E3), historical contributions (Figure E4); historical fit (Figure E5), and model residuals (Figure E6). The scenario conditional forecasts for the NFC segment were computed as an average of the three model variants' conditional forecasts. The projections from all models are shown in Figure 14.

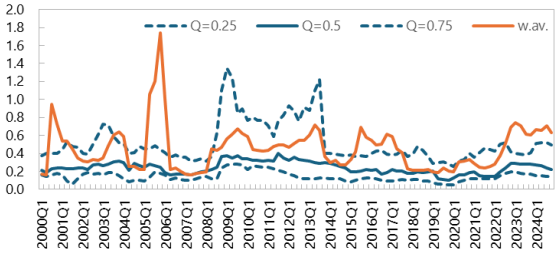
[47] Gross and Población (2019).

Appendix V. Figure 1. Switzerland: Corporate Sector PDs: Historical Data

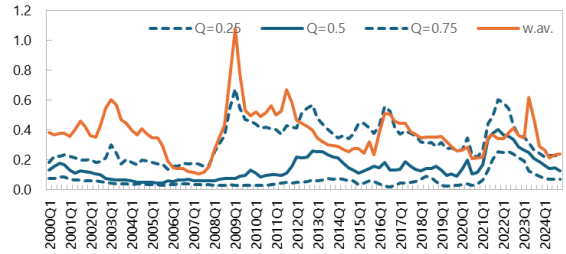
A. PDs—NFC
(percent, 2000Q1-2024Q4)



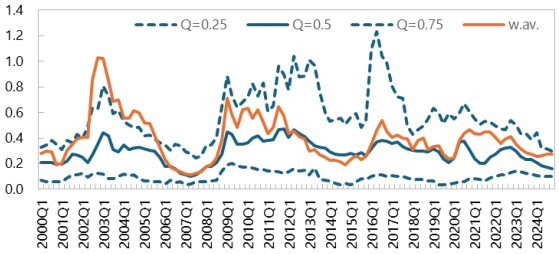
B. PDs—CRE
(percent, 2000Q1-2024Q4)



C. PDs—Banks
(percent, 2000Q1-2024Q4)



D. PDs—NBFIs
(percent, 2000Q1-2024Q4)

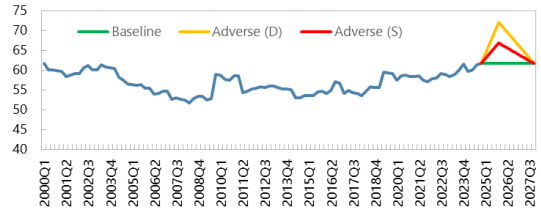


Sources: Moody's Credit Edge and IMF staff calculations.

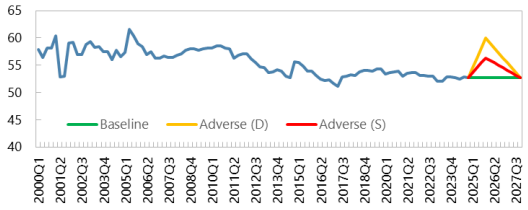
Notes: The historical data for the four corporate sub-segments are based on a cross-section of underlying individual firms. The weighted averages (orange) use the firms' individual debt as weights. The PDs at underlying firm level are within quarter averages. The weighted averages in the cross-section were then computed based on end-quarter debt balances.

Appendix V. Figure 2. Switzerland: Corporate Sector Leverage: Scenario Assumptions

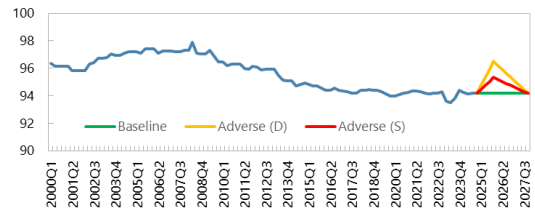
A. Leverage—NFC
(percent)



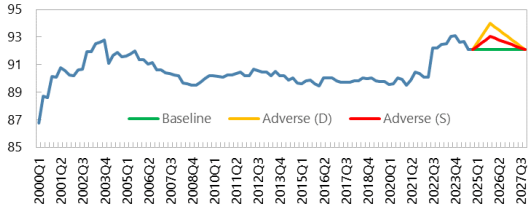
B. Leverage—CRE
(percent)



C. Leverage—Banks
(percent)



D. Leverage—NBFIs
(percent)



Sources: Moody's Credit Edge and IMF staff calculations.

Notes: Leverage is defined as the debt over the market value of assets. The leverage metric is an asset weighted aggregate over an underlying firm sample per point in time. The scenario horizon spans the 2025Q1-2027Q4 period. Adverse (D) and (S) denote the demand and supply shock scenarios, respectively.

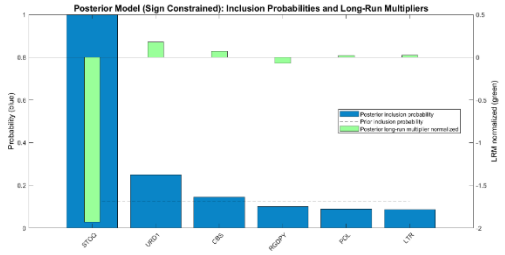
Appendix V. Table 1. Switzerland: Corporate Sector PDs: BMA Model Inclusion Settings and Sign Constraints

#	Variable	Transformation	Alias	PD NFC	PD CRE	PD BA	PD NBFI
1	Real GDP growth	QoQ	RGDPQ	-1	-1	-1	-1
2		YoY	RGDPY	-1	-1	-1	-1
3	Unemployment rate	Level	UR	1	1	1	1
4		Diff QoQ	URD1	1	1	1	1
5		Diff YoY	URD4	1	1	1	1
6	Short-term interest	Level	STR	1	1	1	1
7		Diff QoQ	STRD1	1	1	1	1
8		Diff YoY	STRD4	1	1	1	1
9	Long-term interest rate	Level	LTR	1	1	1	1
10		Diff QoQ	LTRD1	1	1	1	1
11		Diff YoY	LTRD4	1	1	1	1
12	Policy rate	Level	POL	1	1	1	1
13		Diff QoQ	POLD1	1	1	1	1
14		Diff YoY	POLD4	1	1	1	1
15	Real effective exchange rate	Level	REER	1	0	0	0
16		QoQ	REERQ	1	0	0	0
17		YoY	REERY	1	0	0	0
18	Residential property prices	QoQ	NRPPQ	0	-1	-1	0
19		YoY	NRPPY	0	-1	-1	0
20	Commercial property prices	QoQ	NCPPQ	0	-1	-1	0
21		YoY	NCPPY	0	-1	-1	0
22	Stock prices	QoQ	STOQ	-1	0	0	0
23		YoY	STOY	-1	0	0	0
24	Real oil prices	QoQ	ROIL CHF Q	1	0	0	0
25		YoY	ROIL CHF Y	1	0	0	0
26	Corporate bond spread		CBS	1	1	1	1
27	Leverage	Level	NFC	1	0	0	0
28			CRE	0	1	0	0
29			BA	0	0	1	0
30			NBFI	0	0	0	1

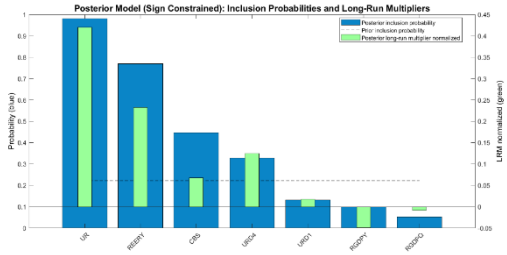
Sources: IMF staff.
Notes: The table summarizes the composition of the predictor pool (potential right hand-side variables) for the corporate PD models. +1 = allow inclusion and set positive LRM sign constraint; -1 = allow inclusion and set negative LRM sign constraint; 0 = do not include a variable in the predictor set.

Appendix V. Figure 3. Switzerland: Corporate Sector PDs: BMA Models—Estimates

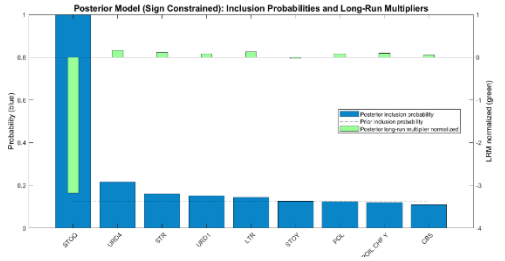
A. NFC—Debt-Weighted PD, Including Stock Prices
(percent on left axis, muliplier on right axis)



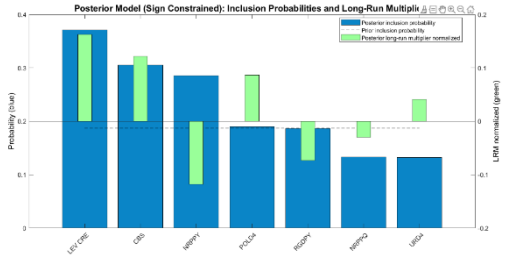
B. NFC—Debt-Weighted PD, Without Stock Prices
(percent on left axis, muliplier on right axis)



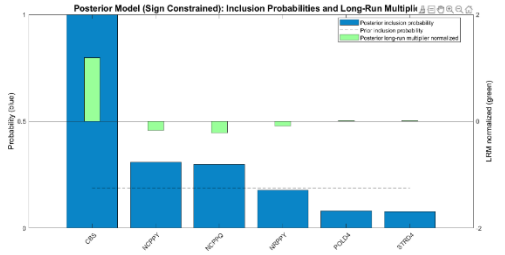
C. NFC—Median PD, Including Stock Prices
(percent on left axis, muliplier on right axis)



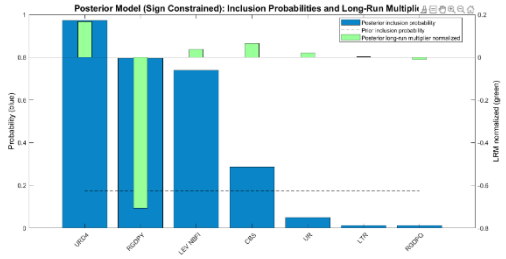
D. CRE
(percent on left axis, muliplier on right axis)



E. Banks
(percent on left axis, muliplier on right axis)



F. NBFIs
(percent on left axis, muliplier on right axis)

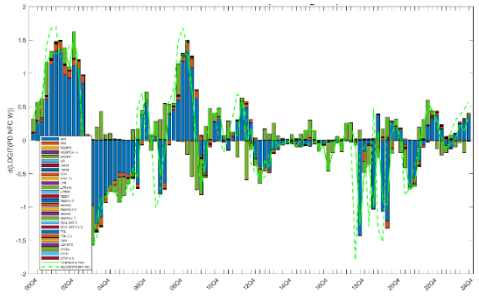


Sources: Moody's Credit Edge and IMF staff models and calculations.

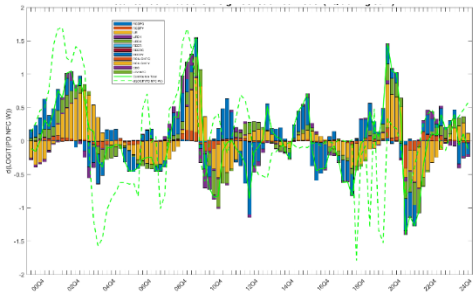
Notes: The charts show the BMA model structure for four portfolio segments, considering three model variants for NFCs (A., B., C.). The underlying models may involve lags of the dependent variable and lags of the right hand-side variables beyond their contemporaneous inclusion. The long-run multipliers shown here (green bars) combine the information contained in their contemporaneous and lagged inclusion.

Appendix 5. Figure 4. Switzerland: Corporate Sector PDs: BMA Models—Historical Contributions

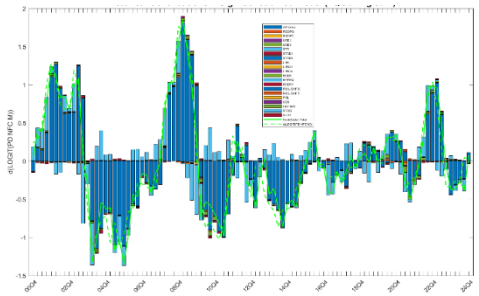
A. NFC—Debt-Weighted PD, Including Stock Prices
(logit delta)



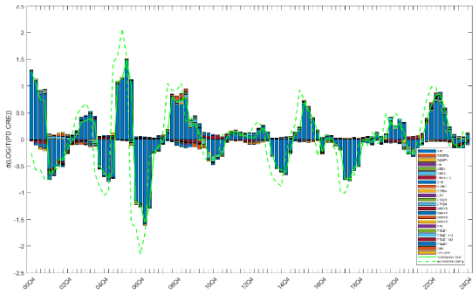
B. NFC—Debt-Weighted PD, Without Stock Prices
(logit delta)



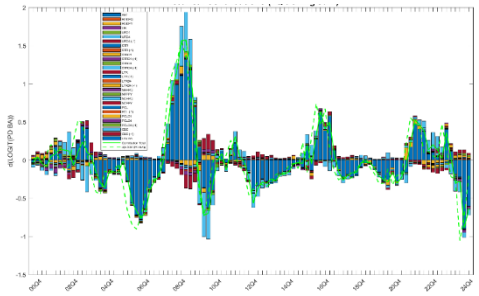
C. NFC—Median PD, Including Stock Prices
(logit delta)



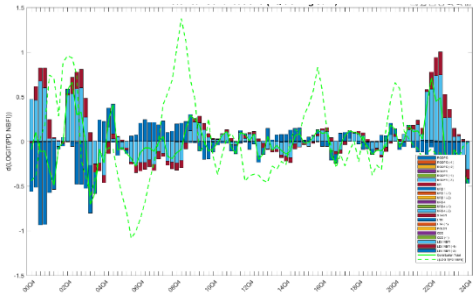
D. CRE
(logit delta)



E. Banks
(logit delta)



F. NBFIs
(logit delta)

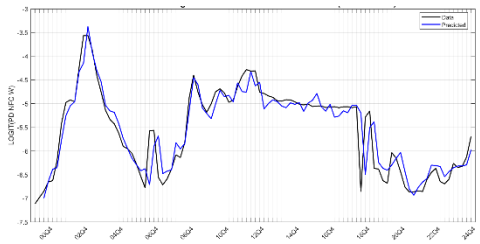


Sources: Moody's Credit Edge and IMF staff models and calculations.

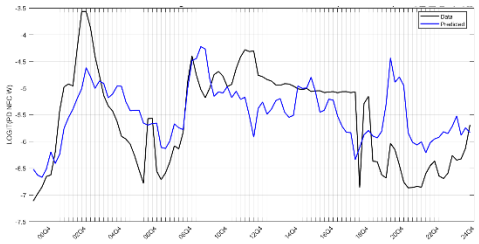
Notes: The historical contributions as shown here combine the contribution from time contemporaneous and lagged terms of the models' dependent variables. The contributions are four-quarter trailing sums.

Appendix V. Figure 5. Switzerland: Corporate Sector PDs: BMA Models—Historical Fit

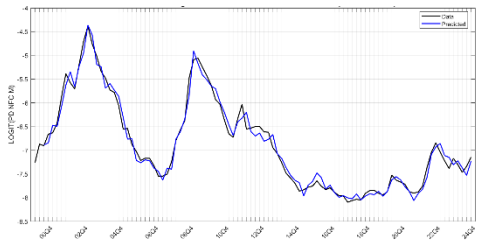
A. NFC—Debt-Weighted PD, Including Stock Prices
(logit; R-square = 0.85)



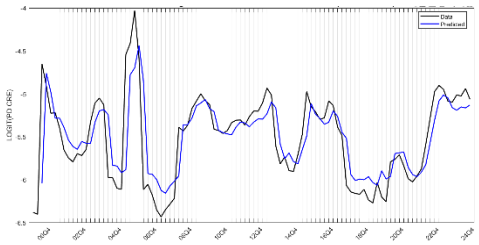
B. NFC—Debt-Weighted PD, Without Stock Prices
(logit; R-square = 0.34)



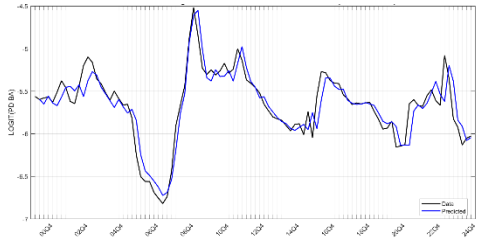
C. NFC—Median PD, Including Stock Prices
(logit; R-square = 0.98)



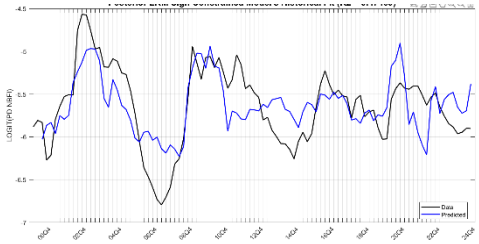
D. CRE
(logit; R-square = 0.59)



E. Banks
(logit; R-square = 0.85)



F. NBFIs
(logit; R-square = 0.47)

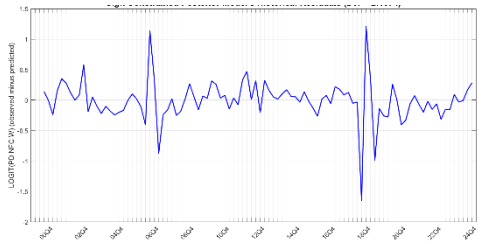


Sources: Moody's Credit Edge and IMF staff models and calculations.

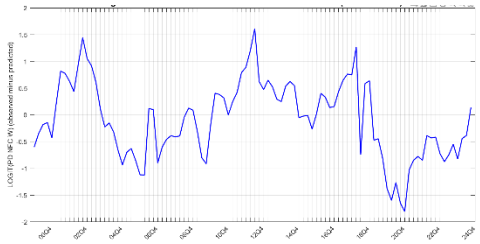
Notes: The historical fit is shown here in the original logit transformation of the PD data. The R-squares indicated in the header include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix V. Figure 6. Switzerland: Corporate Sector PDs: BMA Models—Residuals

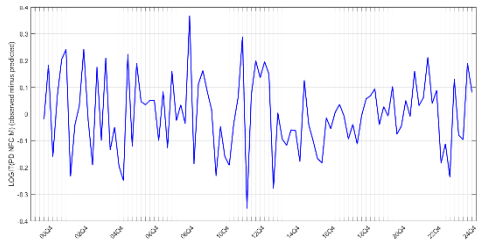
A. NFC—Debt-Weighted PD, Including Stock Prices
(difference of PD fit and PD observed, both in logit; DW = 2.2)



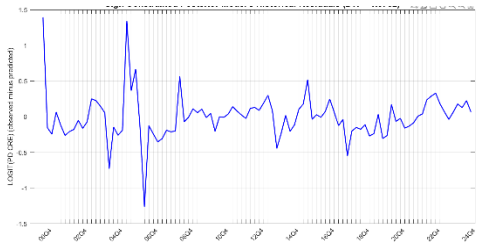
B. NFC—Debt-Weighted PD, Without Stock Prices
(difference of PD fit and PD observed, both in logit; DW = 0.4)



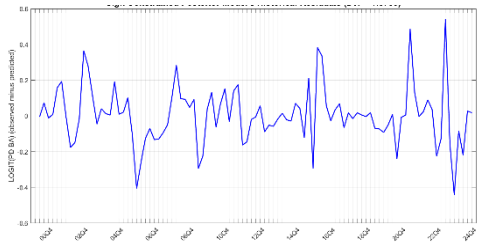
C. NFC—Median PD, Including Stock Prices
(difference of PD fit and PD observed, both in logit; DW = 2.2)



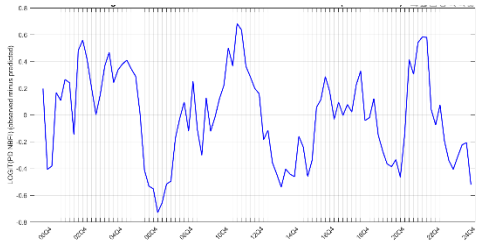
D. CRE
(difference of PD fit and PD observed, both in logit; DW = 1.4)



E. Banks
(difference of PD fit and PD observed, both in logit; DW = 1.6)



F. NBFIs
(difference of PD fit and PD observed, both in logit; DW = 0.4)



Sources: Moody's Credit Edge and IMF staff models and calculations.

Notes: The historical residuals are based on the original logit model transformation of the PD data. The Durbin Watson statistics indicated in the header include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix VI. Household Sector Model

Model Structure at a Glance

1. A micro data-based structural household sector model was set up for Switzerland. The model of Gross and Población (2017) and Gross et al. (2022) was set up based on data from the Statistics on Income and Living Conditions (SILC), including the wealth-specific variables module from 2022, and the Household Budget Survey (HBS), both from the Federal Statistical Office (FSO). An additional module containing wealth data was included in the SILC dataset. While the model draws most of its data from the SILC (2022) with wealth-specific variables, the HBS (2015-2017) provided complementary information on household living expenses. The SILC dataset for 2022 contained 8,900 households and 19,229 household members. The HBS contained a total of 9,955 households.

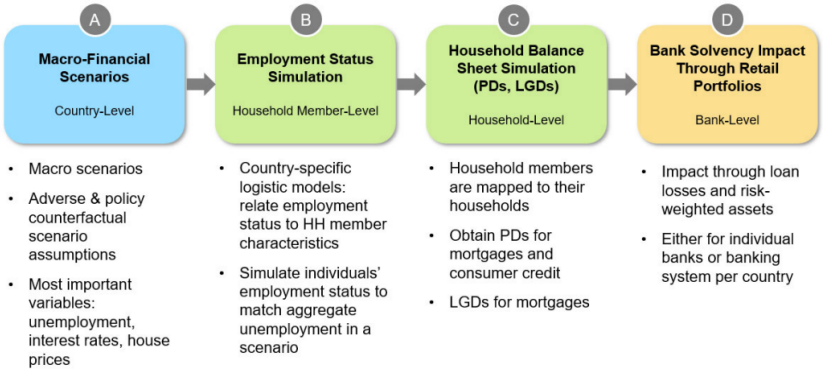
2. The model entails the structural forward simulation of household income, expenses, and the implied balance sheet evolution. The model structure is summarized in Figure F1. The household balance sheet mechanics and default definition are summarized in Figure F2. The structural drivers captured by the model are summarized in Table F1. The detailed model description can be found in the above-mentioned two references.[48] Regarding the default definition, the one excluding a role for house prices was considered for Switzerland, given the full recourse environment in which mortgage borrowers do not have any notable incentives for strategic default as a result specifically of the value of real estate collateral falling short of outstanding debt.

3. The logistic model for individuals' employment status was estimated based on the Swiss SILC data. The logistic model estimates (Table F2) were based on data for 11,438 individuals, whose status was either employed (=1) or unemployed (=2). Seven regional indicators were included, the first one of which was the reference, the Lake Geneva region. The model has an AUROC of 0.67 and a GINI of 0.34. One important mechanism involved in the model entails the stochastic drawing from the employment status model, involving an intercept shift therein to match a target aggregate unemployment rate provided in a scenario.

4. Various additional parameters are needed to operate the model. These include, for example, the unemployment benefit replacement rate, which is relevant for individuals that become unemployed during the model simulations; and further the variable rate shares, pass-through estimates from policy rates to bank deposit rates, and others. See Table F3.

[48] Another recent application of the model was the IMF Japan FSAP 2024. See Japan: Financial Sector Assessment Program-Technical Note on Systemic Risk Analysis and Stress Testing.

Appendix VI. Figure 1. Switzerland: IDHBS Model Structure for4 its Application to Switzerland



Source: Figure 1 in Gross et al. (2022).

Appendix VI. Figure 2. Switzerland: Household Balance Sheet Mechanics and Default Definition

Financial asset stocks ($FA_{hh,t}$) at HH-level move according to:

$$\Delta FA_{hh,t} = II_{hh,t} + OI_{hh,t} - E_{hh,t} - A^{Tot,Q}_{hh,t} - OE_{hh,t} + \begin{cases} INC^{E}_{n,t}(1-\tau_c), & \text{empl. HH members} \\ INC^{U}_{n,t}, & \text{unempl. HH members} \end{cases} + \Delta B_{hh,t} + \Delta S_{hh,t}$$

- $II_{hh,t}$: Interest income, e.g. on deposits
- $OI_{hh,t}$: Other certain income, e.g. child benefit and alimony
- $E_{hh,t}$: Consumption expenses
- $A^{Tot,Q}_{hh,t}$: Debt service flow for consumer and/or mortgage debt
- $OE_{hh,t}$: Other expense, e.g. rent
- $INC^{E}_{n,t}(1-\tau_c)$ / $INC^{U}_{n,t}$: Stochastically simulated and macro-consistent employment status of HH members from employment simulator (Module B) determines whether employment income or unemployment benefit is received
- $\Delta B_{hh,t}$: Change in market value of bonds
- $\Delta S_{hh,t}$: Change in market value of stocks

Default criterion for debt-holding HHs, two options:

For full-recourse systems

$$\text{Default in } t+h := \begin{cases} 1 & \text{if } FA_{hh,t+h} < 0 \\ 0 & \text{otherwise} \end{cases}$$

For limited-recourse systems (House value, Principal debt balance)

$$\text{Default in } t+h^{*} := \begin{cases} 1 & \text{if } FA_{hh,t+h} < 0 \text{ or } V_{hh,t+h} < P_{hh,t+h} \\ 0 & \text{otherwise} \end{cases}$$

- In both cases in line with 90-day past due criterion, since simulation runs at quarterly frequency → instrumental for linking to bank balance sheets

Source: Gross and Poblacion (2017) and Gross et al. (2022).

Appendix VI. Table 1. Switzerland: Structural Drivers of Household Default and LGDs Captured by the IDHBS Model

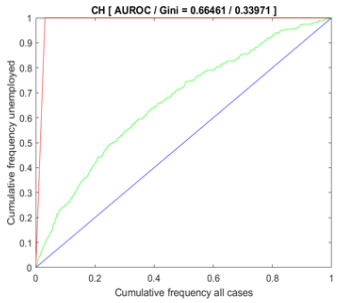
	Primary Drivers	Secondary Drivers
Probability of Default (PD)	(1) **Unemployment** [+] (2) **Interest rates**, via - influencing deposit interest income [-] - interest expense for variable-rate debt [+] - bond valuation [secondary, +] (3) **House price growth**, in limited-recourse systems via changing strategic default incentive [-]	(4) **Income growth**, for - employed and self-employed HMs' income [-] - unemployed via anchoring replacement wage in previous employment income [-] (5) **Stock price returns**, for shareholders [-]
Loss Given Default (LGD)	(1) **House price growth** [-] (2) **Cure rate** [-] (3) **Interest rates** [+], for discounting under economic LGD model mode	(4) **Administrative costs** [+]

Source: Figure 2 in Gross et al. (2022).

Note: The signs in brackets indicate the relationship (direct and ceteris paribus) between PDs/LGDs (specifically for mortgage debt) and their drivers, as captured in the structural model. The difference between primary and secondary drivers relates to their importance in terms of economic impact on PDs and LGDs.

Appendix VI. Table 2. Switzerland: Logistic Model for Employment Status

		0	1	Coefficient	p-value	Odds ratio
Const.				5.83	0%	
MAR	Marital status	Single	Other	0.64	0%	1.9
EDU	Education	Low	High	0.72	0%	2.0
GEN	Gender	Male	Female	-0.02	85%	1.0
DF	Domestic-foreign	Dom.	Foreign	-0.82	0%	0.4
AGE	Age			0.55	0%	1.7
REG2	Espace Mittelland			0.36	5%	1.4
REG3	Northwestern Switzerland			0.51	0%	1.7
REG4	Zurich			0.37	4%	1.4
REG5	Eastern Switzerland			0.67	0%	1.9
REG6	Central Switzerland			0.29	27%	1.3
REG7	Ticino			-0.01	4%	1.0



Source: SILC and IMF staff models and calculations.

Appendix VI. Table 3. Switzerland: Selected IDHBS Model Parameters

Parameter	Value	Source	Comment
Replacement rate	72%	OECD	Unemployment benefit over last employment income net of tax
Maximum unemployment benefit per month in CHF	7,970	Swiss State Secretariat for Econ. Affairs (SECO)	
Variable rate share of total household debt	20%	SNB and own calculations	Informed by data from banks and HypoB
Pass-through from policy to deposit rate (up)	0.25	SNB and own estimates	Informed by estimates from models for interest expenses from solvency stress test
Pass-through from policy to deposit rate (down)	0.35	SNB and own estimates	
PD anchor for mortgage debt	0.5%	SNB/FINMA	Informed by data from banks
PD anchor for other debt	1.5%	Own calculations	Involving interest rate spread and LGD data for non-mortgage debt
LGD anchor for mortgage debt	10%	SNB/FINMA	Informed by data from banks
Cure rate (for LGD module)	20%	Data from banks	Assumption
Interest rate for "other debt" in 2022	4.7%		Informed by historical interest rate data

Source: OECD, SECO, SNB, FINMA, and IMF staff calculations.
Note: The table summarizes some primary model parameters that were relevant for the Switzerland application.

Data Specificities

5. Household expenses were not included in the SILC micro data and had to be taken from an alternative source. This alternative source was the Household Budget Survey (HBS), also provided by the FSO. Living expense ratios were computed based on HBS data, expressing expenses as a percentage of household gross income, to then assign these ratios and impute living expenses based on SILC data (anchored in gross income from SILC). Three groups were considered for these calculations: (i) owners without mortgages, (ii) owners with mortgages, and (iii) renters (39 percent of the households). For non-renters with mortgages, the ratio does not include the net rent and mortgage on the main and another residence, given that they would be considered from SILC variables; for the owners groups, the fire insurance and other building damage premiums are identified and used for increasing the insurance expenses for the climate risk analysis. The model input data considers the median living expenses ratio in each gross income decile for the owners with mortgages and renters, while quintiles for the owners without mortgages, due to the limited number of households in this group.

6. Household members' model inputs came from SILC, some with treatments to adapt them to the model structure, and requirements. The model input considers SILC (2022) for household member variables, some recoded, and two with further treatments: (i) economic status and (ii) income (employment and unemployment). For economic status, the model input considered three statuses (employment, unemployment, and other); whenever the economic status was not available, for a household member above 15 of age, it was defined with the income from the

household member: (i) with unemployment benefits set as unemployed; (i) only employment income set as employed, and (iii) no employment income or unemployment benefit set to other. For employment income and unemployment benefits, net income under a different statuses was required and defined as:

(i) Only employment income, calculate the unemployment benefit with the replacement rate[1] without self-employment income.

(ii) Only unemployment benefit, calculate the employment income with the inverse of the replacement rate.

(iii) Employment and unemployment income: (a) calculate the employment income as the sum of the employment income and the unemployment income converted to employment income, as in (i); and (b) the unemployment income as the sum of the unemployment income and the employment income converted to unemployment income, as in (ii).

7. Household level data included assets, liabilities, and main residence mortgage flows from SILC. From the household level data from SILC, the main inputs corresponded to household assets (property value, bank accounts, bonds, and stocks) and liabilities (mortgage and non-mortgage), available from the wealth-specific variables. Also, the household characteristics and debt flows (principal and interest from the main residence) came from SILC. Regarding house ownership, most households that own their main or other residence do it through a mortgage, which is the main component of household liabilities, with less than 30 percent of households having just non-mortgage debt (Table F4). The percentage of owners of the main residence from SILC (with and without a mortgage) and non-renters from HBS are aligned, with 38 and 39 percent, respectively.

Appendix VI. Table 4. Switzerland: Household Assets and Liabilities
Percentage of Households

Assets		Liabilities	
Owns main residence	38%	Mortgage main residence	34%
Owns only other residence	9%	Mortgage other residence	10%
		Non-mortgage debt	24%
Bank accounts	95%		
Bonds or stocks	36%	Mortgage main or other residence	38%
		Mortgage main and other residence	6%
		Mortgage and non-mortgage	8%
		Non-mortgage only	15%
		With debt	53%

Sources: SILC (2022) and IMF staff calculations.

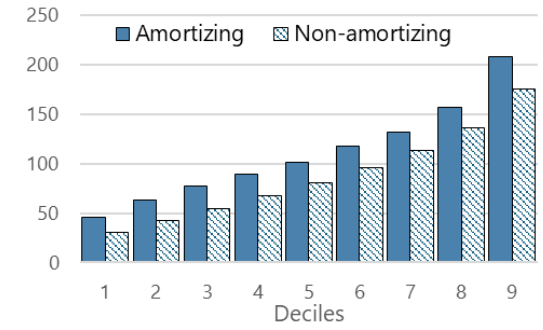
8. Property values as reported in SILC required additional calculations, as did the split of debt into mortgage and non-mortgage, with respective interest and principal flows. Similar to the household member data, the household inputs required some calculations, mainly related to property values and debt flows. Regarding property values, the main treatments were defining the value type when non-reported and updating values using the residential property price index. For

mortgage and non-mortgage payments, SILC has information on interest and principal payments for the main residence; still, there is no information on the second residence, and second resident debt interest payments are bundled with non-mortgage. To construct the flow variables for the second residence: (i) for households with mortgages in the main residence, the second residence flow ratios were set equal to the interest and principal flow ratios from the main residence, and (ii) for households with no mortgages in the main residence, the imputed values correspond to the 75th percentile of the interest and principal flow ratio in each income quartile from the households with mortgages in the main residence. With this treatment, the data input was the total mortgage debt (main and other residence) and payments, differentiating interest and principal components. For non-mortgage debt, the input used the maturity of the non-mortgage portfolios and an estimated interest rate to derive principal and interest flows.

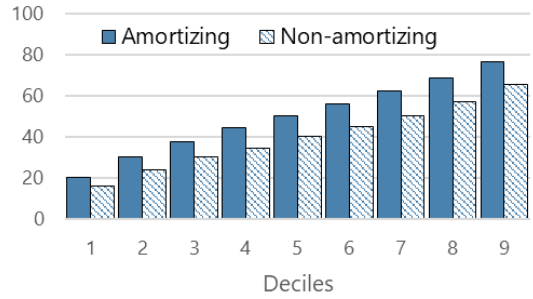
9. The model's debt data reveals differences between amortizing and non-amortizing loans and is aligned with banks' new loan data. For the model input, the debt stock and flows were arranged into mortgage and non-mortgage, from which the principal repayment variable defines whether a loan is amortizing. The input data shows that income is higher in amortizing mortgages, LTVs are lower in the non-amortizing (as expected and aligned with the "industry standard" of non-amortizing loans below 66 percent LTV), interest rates are higher in amortizing loans, and DSTI is also higher for amortizing mortgages. The household input data also aligns with banks new owner-occupied mortgages from 2017 to 2024, showing similar levels of disposable income and LTVs (Figure F2).

Appendix VI. Table 5. Switzerland: Household Mortgage Characteristics

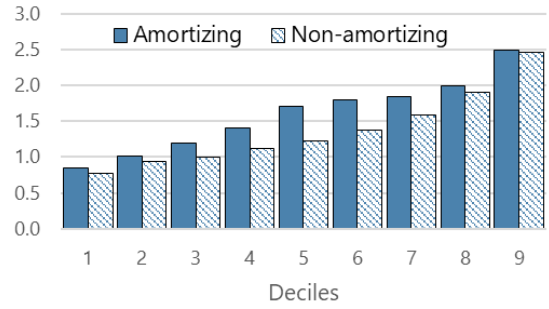
A. Annual Disposable Income for Households with Mortgages
(CHF thousands)



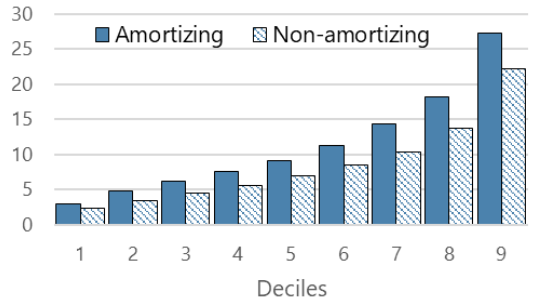
B. LTV Ratios for Household Mortgage Debt
(CHF thousands)



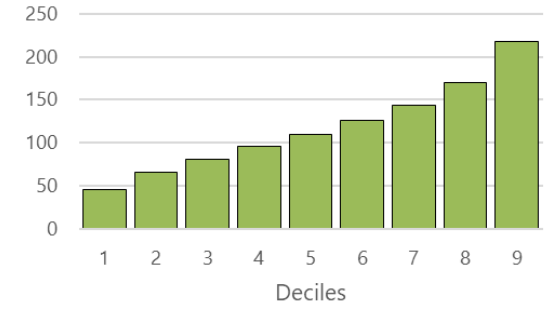
C. Interest Rate for Mortgage Debt
(percent)



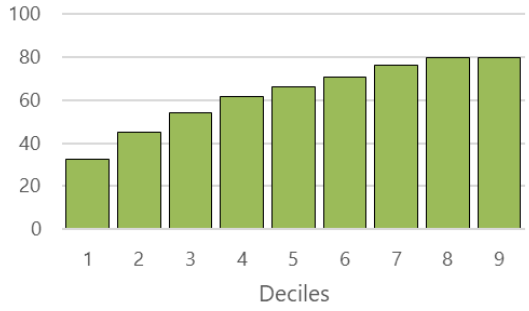
D. DSTI Ratios for Mortgage Debt
(percent; mortgage debt service over disposable income)



E. Income for Newly Granted Mortgages for Household Owner-Occupied Real Estate
(CHF thousands, new mortgages 2017-2024)



F. LTV Ratios for Newly Granted Mortgages for Household Owner-Occupied Real Estate
(percent, new mortgages 2017-2024)



Sources: SILC (2022) and IMF staff calculations.

Appendix VII. Bank Interest Income and Expense Models

1. Panel econometric models were set up for projecting interest income and expenses for the individual banks in the bank solvency stress test. The models were set up for each bank cluster. The SIBs, asset managers, and residual bank clusters were further split into domestically active and cross-border active banks sub-clusters. For the foreign bank sub-clusters, a dependence on certain foreign interest rates was allowed in addition to domestic drivers. The cost of funding models allowed for an asymmetric response to changes in policy and market rates, depending on their direction of change. Feedback from solvency ratios of banks to their cost of funding was allowed. The interest income models capture the pass-through from policy rates and banks' own cost of funding, allowing also here for a potential asymmetry. The interest income rates were defined as banks' trailing annual sum of interest income over annual trailing average interest bearing assets. This means that the models are based on outstanding stocks, not the rates on new lending. This is why these models were set to contain an autoregressive lag, to capture the implied rate persistence.

2. Some takeaways from the COF and IIR model estimations include:

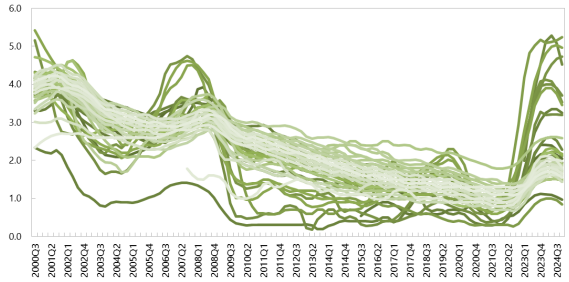
- **COF models**: Systematic evidence was found for an asymmetric response of banks' cost of funding to up- vs. downward moves in policy and market rates. Further, an economically non-negligible feedback from bank capital ratios to their COF was found. The fit of the COF models is reasonable despite the models having no autoregressive lags.

- **IIR models**: An asymmetric response of IIRs to changes in policy and market rates was found, although the asymmetry is not as pronounced as for the COF models. Macroeconomic control variables were not found to be too relevant.

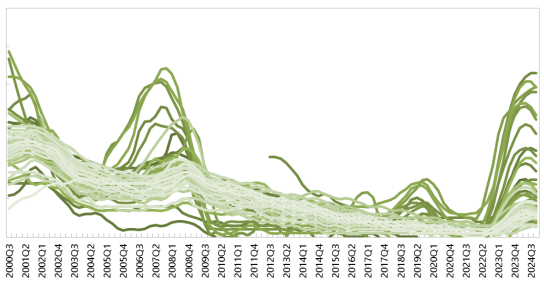
The raw data underlying the interest income and expense models are shown in Figure G1. Model coefficient estimates are shown in Figure G2. The projections for the cost of funding and the interest income rates, in both cases at cluster aggregate level, are shown in Figs. G3 and G4.

Appendix VII. Figure 1. Switzerland: Bank Interest Income and Cost of Funding

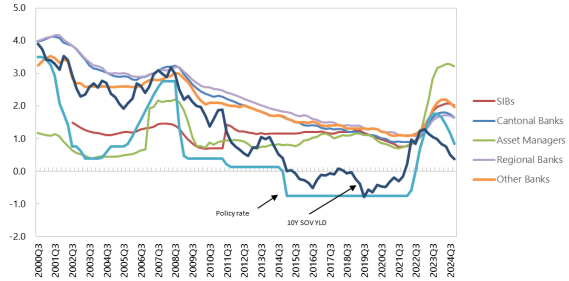
A. Interest Income Rates (IIRs)
(annual rates in percent, data for 92 banks, 2000Q3-24Q4)



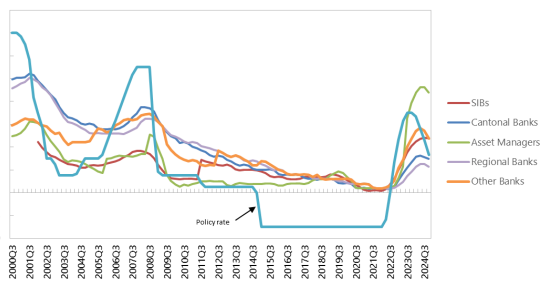
B. Cost of Funding (CoF)
(annual rates in percent, data for 92 banks, 2000Q3-24Q4)



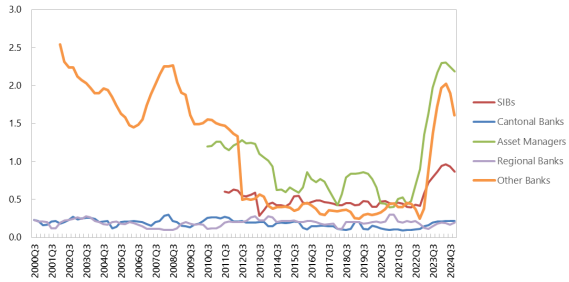
C. Interest Income Rates (IIRs)—Cluster Aggregates
(percent, median across banks per cluster, within-quarter av.)



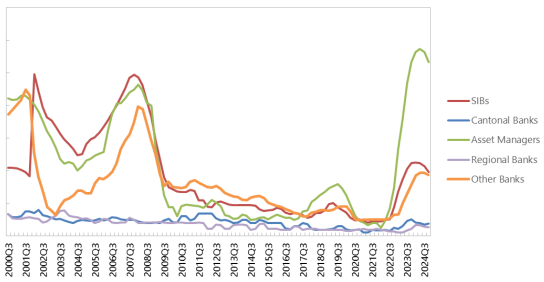
D. Cost of Funding (CoF)—Cluster Aggregates
(percent, median across banks per cluster, within-quarter av.)



E. Interest Income Rates (IIRs)—Interquartile Ranges
(percentages points)



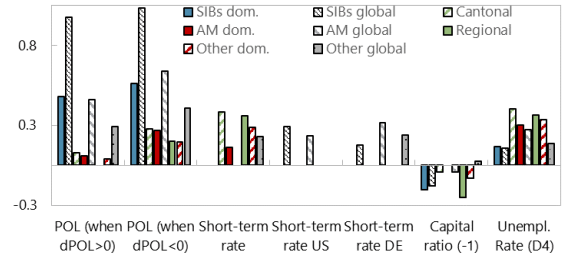
F. Cost of Funding (CoF)—Interquartile Ranges
(percentages points)



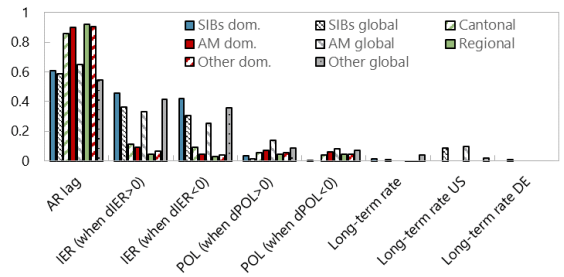
Sources: SNB, FINMA, and IMF staff calculations.

Appendix VII. Figure 2. Switzerland: Cost of Funding and Interest Income Models

A. Cost of Funding Models
(coefficients)



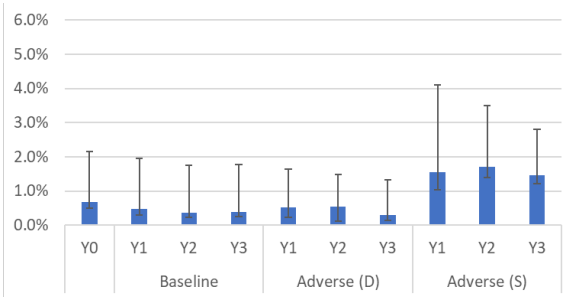
B. Interest Income Rate Models
(coefficients)



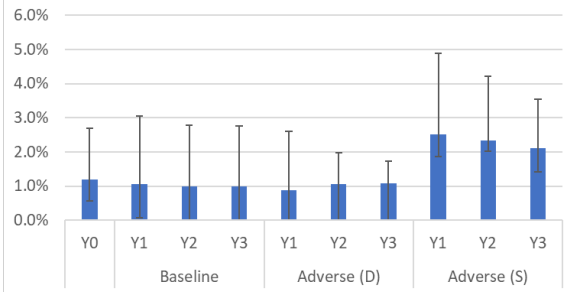
Sources: SNB, FINMA, and IMF staff calculations.
Notes: The coefficient estimates in this panel are obtained from bank cluster specific panel models, estimated using EGLS, based on quarterly data for 92 banks in total across clusters, covering the 2000Q3-2024Q4 period.

Appendix VII. Figure 3. Switzerland: Cost of Funding Projections

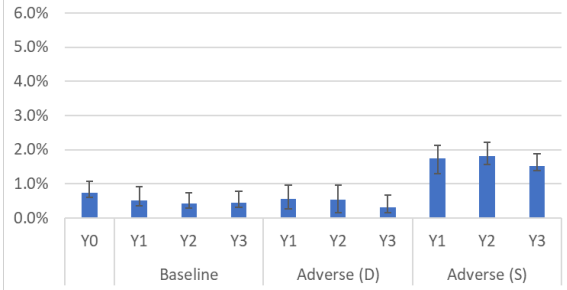
A. COF Projections: All Banks
(percent)



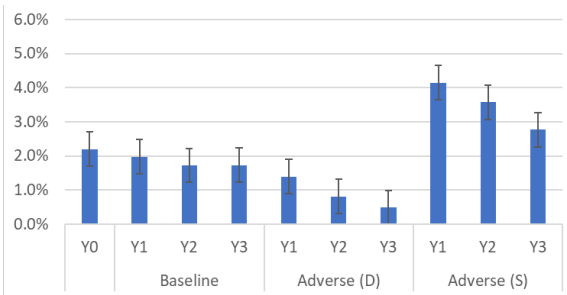
B. COF Projections: SIBs
(percent)



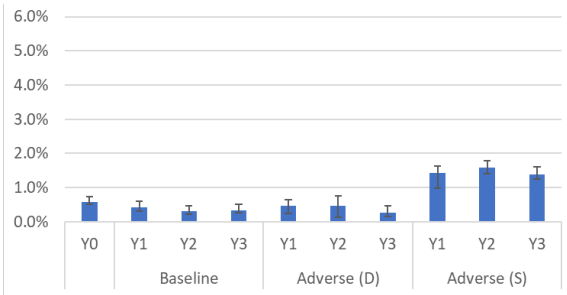
C. COF Projections: Cantonal Banks
(percent)



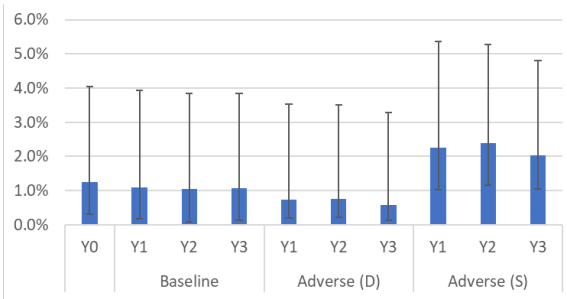
D. COF Projections: Asset and Wealth Managers
(percent)



E. COF Projections: Regional Banks
(percent)



F. COF Projections: Other Banks
(percent)

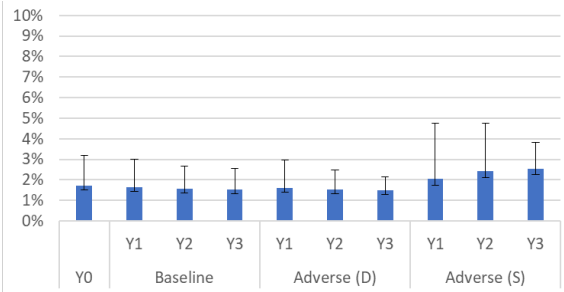


Sources: SNB, FINMA, and IMF staff calculations.

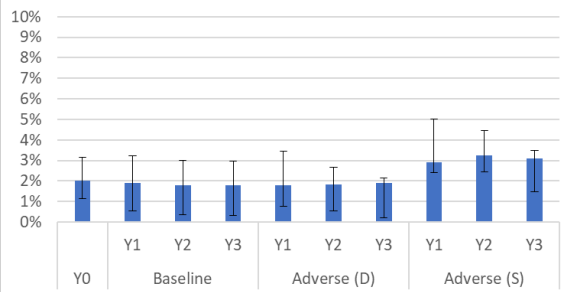
Notes: The bars represent the medians across the underlying banks in the respective clusters. The error bars extent to the 10th and 90th percentiles. The vertical axes are set to a common range as a visual support for cross-cluster comparison.

Appendix VII. Figure 4. Switzerland: Interest Income Rate (IIR) Projections

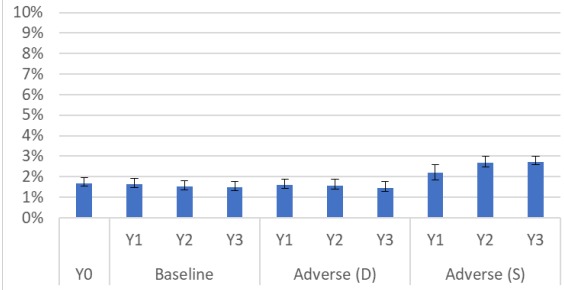
A. IIR Projections: All Banks
(percent)



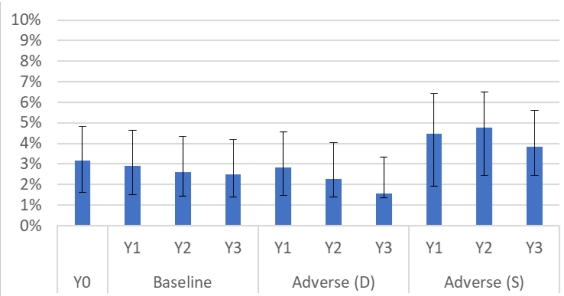
B. IIR Projections: SIBs
(percent)



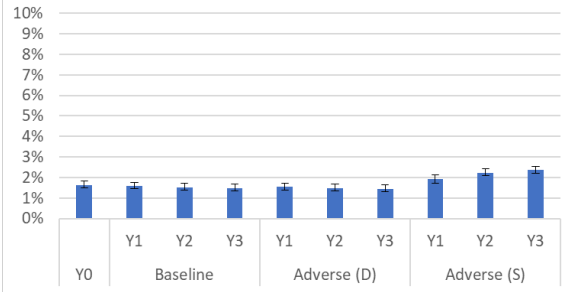
C. IIR Projections: Cantonal Banks
(percent)



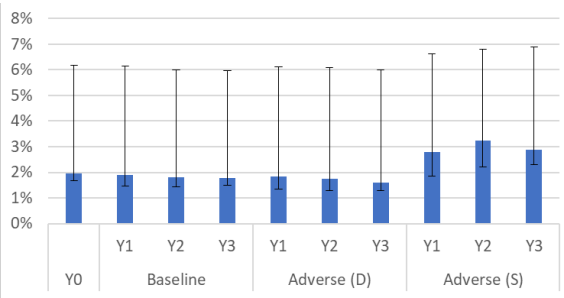
D. IIR Projections: Asset and Wealth Managers
(percent)



E. IIR Projections: Regional Banks
(percent)



F. IIR Projections: Other Banks
(percent)



Sources: SNB, FINMA, and IMF staff calculations.

Notes: The bars represent the medians across the underlying banks in the respective clusters. The error bars extent to the 10th and 90th percentiles. The vertical axes are set to a common range as a visual support for cross-cluster comparison.

Appendix VIII. Bank Fee and Commission Income Models

1. The historical data for FCI and fee expenses was compiled in four categories: FC expense and three FC income items, the latter pertaining to banks' assets under management (AUM), credit granting, and a residual category. The credit and residual sources of FCI contribute quantitatively notably less to total FCI than that from banks' AUM. The modeling priority was therefore assigned to FCI from AUM.

2. The model approaches were as follows: (1) FX expense ratios relative to total assets were held constant; (2) FCI from AUM were modeled using a panel BMA methodology, to model the ratios of FC income from AUM relative AUM as a function of macrofinancial conditions; (3) FC income for credit and residual business (both relative to total assets) were held constant under the baseline and following a predefined percentile path under the two adverse scenarios. The BMA model settings for the FCI for AUM are shown in Table H1. The BMA model results are collected in Figures H1-H5 for the five bank clusters. The percentile paths for the FCI ratios for credit and other business are in Figure H6. The projections of the various ratios from the three FCI categories (medians over banks per cluster) are shown in Figures H7-H9.

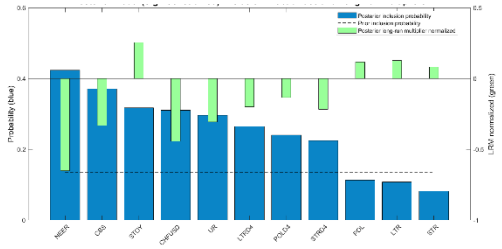
Appendix VIII. Table 1. Switzerland: Panel BMA Models for Bank Fee and Commission Income from AUM—Inclusion Settings and Sign Constraints

#	Variable	Transformation	Alias	Inclusion setting
1	Real GDP growth	QoQ	RGDPQ	1
2		YoY	RGDPY	1
3	Unemployment rate	Level	UR	-1
4		Diff QoQ	URD1	-1
5		Diff YoY	URD4	-1
6	Short-term interest rates	Level	STR	0
7		Diff QoQ	STRD1	0
8		Diff YoY	STRD4	0
9	Long-term interest rate	Level	LTR	0
10		Diff QoQ	LTRD1	0
11		Diff YoY	LTRD4	0
12	Policy interest rate	Level	POL	0
13		Diff QoQ	POLD1	0
14		Diff YoY	POLD4	0
15	Nominal effective	Level	NEER	-1
16	exchange rate	QoQ	NEERQ	-1
17		YoY	NEERY	-1
18	CHFUSD exchange rate	Level	CHFUSD	-1
19		QoQ	CHFUSDQ	-1
20		YoY	CHFUSDY	-1
21	Stock prices	QoQ	STOQ	1
22		YoY	STOY	1
23	Corporate bond spread	Level	CBS	-1

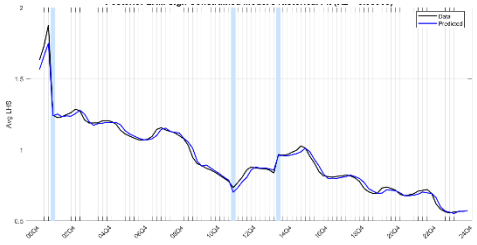
Sources: IMF staff.
Notes: The table summarizes the composition of the predictor pool (potential right hand-side variables). +1 = allow inclusion and set positive LRM sign constraint; -1 = allow inclusion and set negative LRM sign constraint; 0 = do not include a variable in the predictor set.

Appendix VIII. Figure 1. Switzerland: Panel BMA Model—FCI for AUM—SIBs

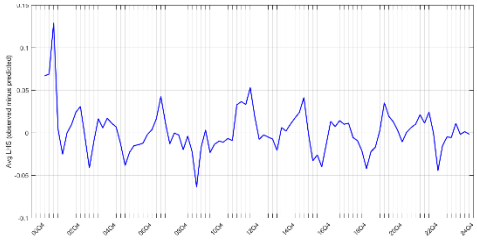
A. Model Structure
(inclusion probabilities in percent and normalized LRMs)



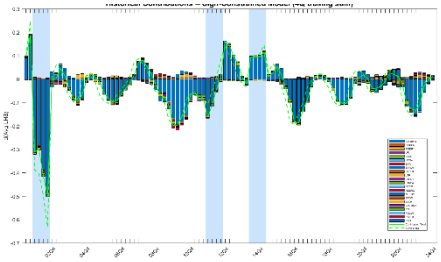
B. Historical Fit
(average over underlying banks; R-square = 0.98)



C. Historical Residuals
(average over underlying banks; DW = 0.82)



D. Historical Contributions
(change in FCI/AUM ratio, average over underlying banks)

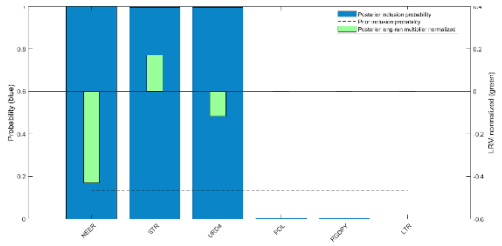


Sources: FINMA, SNB, and IMF staff models and calculations.

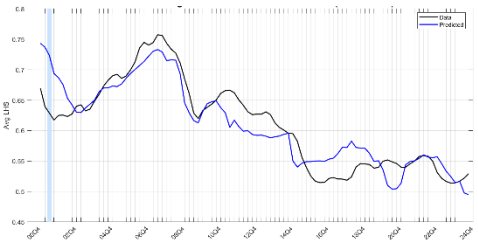
Notes: The R-squares and DW statistics in panels B. and C. include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix VIII. Figure 2. Switzerland: Panel BMA Model—FCI for AUM—Cantonal Banks

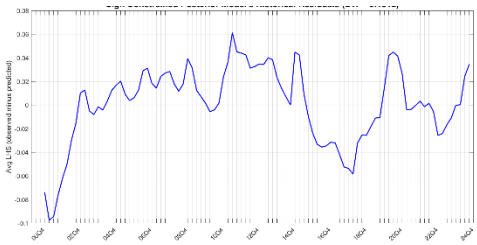
A. Model Structure
(inclusion probabilities in percent and normalized LRMs)



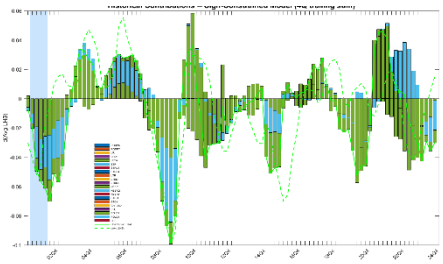
B. Historical Fit
(average over underlying banks; R-square = 0.80)



C. Historical Residuals
(average over underlying banks; DW = 0.6)



D. Historical Contributions
(change in FCI/AUM ratio, average over underlying banks)

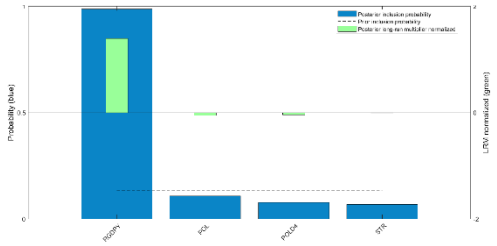


Sources: FINMA, SNB, and IMF staff models and calculations.

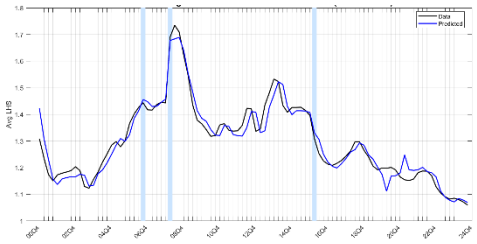
Notes: The R-squares and DW statistics in panels B. and C. include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix VIII. Figure 3. Switzerland: Panel BMA Model—FCI for AUM—Asset and Wealth Management Banks

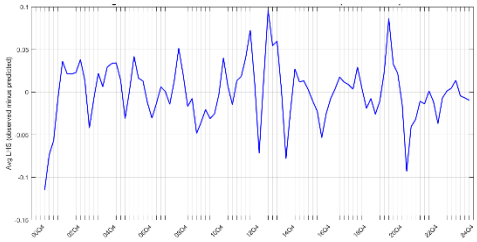
A. Model Structure
(inclusion probabilities in percent and normalized LRMs)



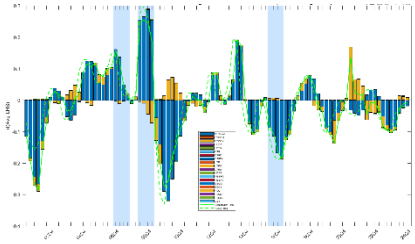
B. Historical Fit
(average over underlying banks; R-square = 0.94)



C. Historical Residuals
(average over underlying banks; DW = 0.9)



D. Historical Contributions
(change in FCI/AUM ratio, average over underlying banks)

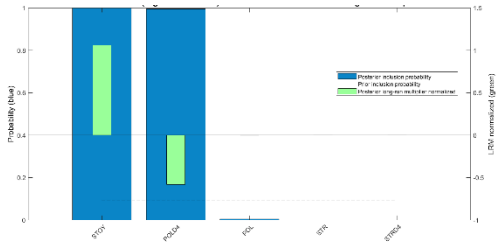


Sources: FINMA, SNB, and IMF staff models and calculations.

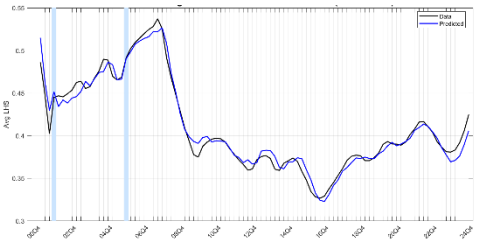
Notes: The R-squares and DW statistics in panels B. and C. include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix VIII. Figure 4. Switzerland: Panel BMA Model—FCI for AUM—Regional Banks

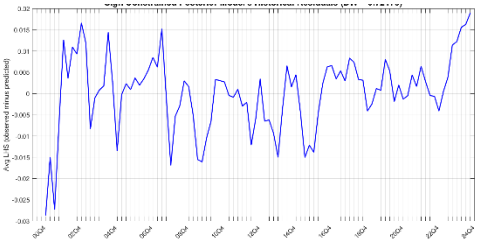
A. Model Structure
(inclusion probabilities in percent and normalized LRMs)



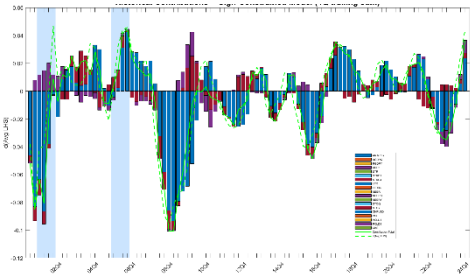
B. Historical Fit
(average over underlying banks; R-square = 0.97)



C. Historical Residuals
(average over underlying banks; DW = 0.7)



D. Historical Contributions
(change in FCI/AUM ratio, average over underlying banks)

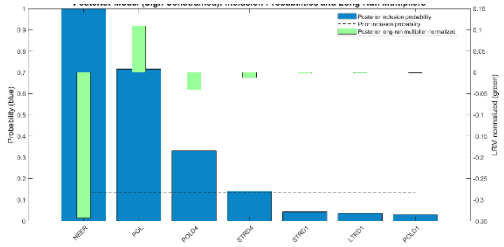


Sources: FINMA, SNB, and IMF staff models and calculations.

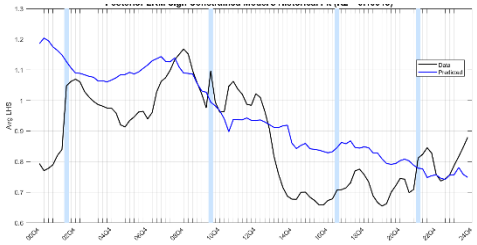
Notes: The R-squares and DW statistics in panels B. and C. include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix VIII. Figure 5. Switzerland: Panel BMA Model—FCI for AUM—Other Banks

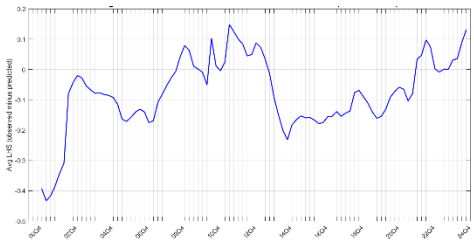
A. Model Structure
(inclusion probabilities in percent and normalized LRMs)



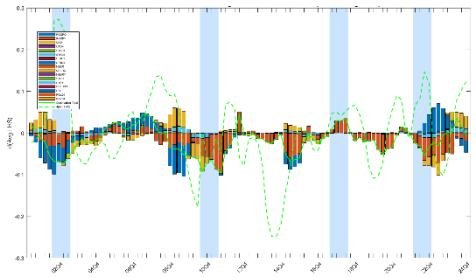
B. Historical Fit
(average over underlying banks; R-square = 0.11)



C. Historical Residuals
(average over underlying banks; DW = 0.2)



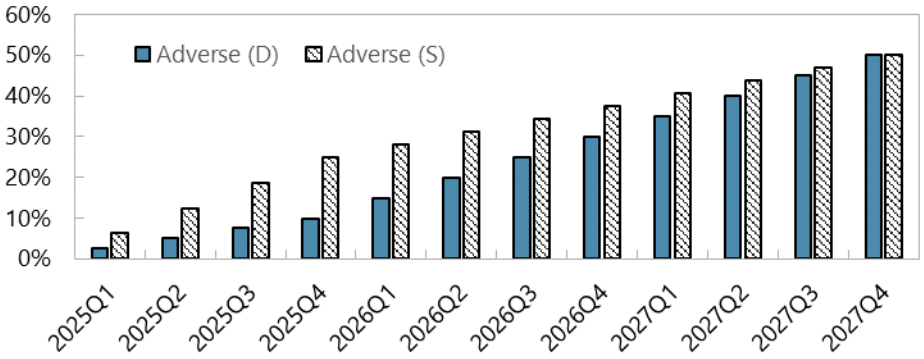
D. Historical Contributions
(change in FCI/AUM ratio, average over underlying banks)



Sources: FINMA, SNB, and IMF staff models and calculations.

Notes: The R-squares and DW statistics in panels B. and C. include the pandemic period in 2020-21, while the model estimation excluded this period.

Appendix VIII. Figure 6. Switzerland: Percentile Paths for FCI from Sources Other than AUM

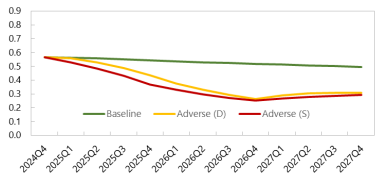


Sources: IMF staff models.

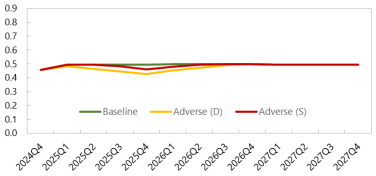
Notes: The chart shows the chosen percentiles that were applied at the bank level to banks' own historical FCI ratios for credit and other business (other than from AUM), to derive their adverse scenario paths along the 12 quarter horizon.

Appendix VIII. Figure 7. Switzerland: FCI from AUM—Projections

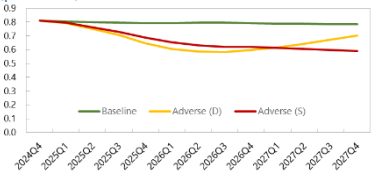
SIBs
(percent)



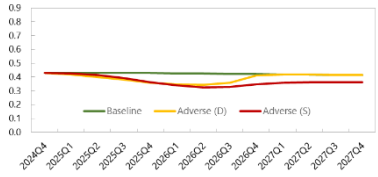
Cantonal Banks
(percent)



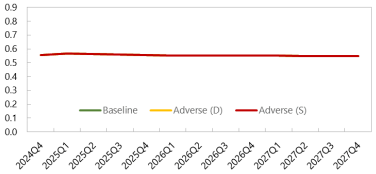
Asset and Wealth Managers
(percent)



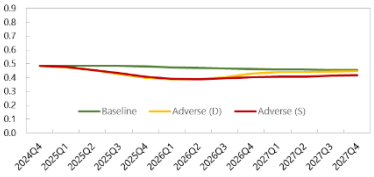
Regional Banks
(percent)



Other Banks
(percent)



All Banks
(percent)

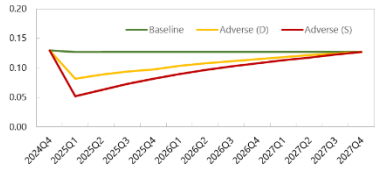


Sources: IMF staff models.

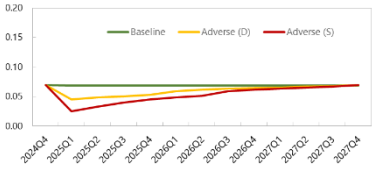
Notes: The FCI ratios here relevant are defined as 4-quarter trailing sums of FCI from AUM over 4-quarter trailing averages of AUM, at bank level. The charts here shown represent medians across the underlying banks. The vertical axes were set to have a common range as a visual support for cross-bank-cluster comparison.

Appendix VIII. Figure 8. FCI from Sources Other than AUM and Credit Business—Projections

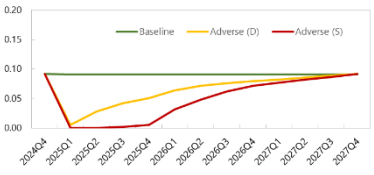
SIBs
(percent)



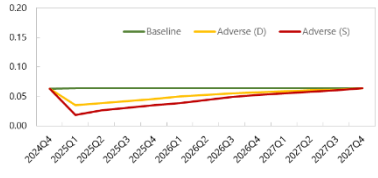
Cantonal Banks
(percent)



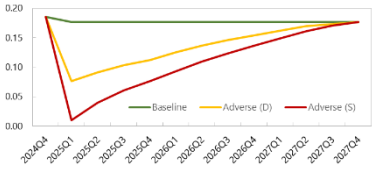
Asset and Wealth Managers
(percent)



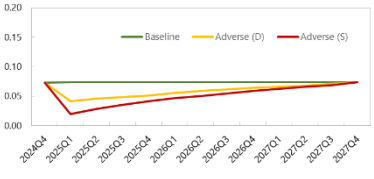
Regional Banks
(percent)



Other Banks
(percent)



All Banks
(percent)

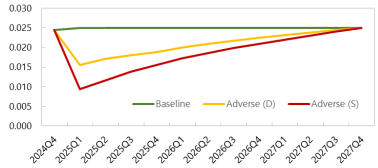


Sources: IMF staff models.

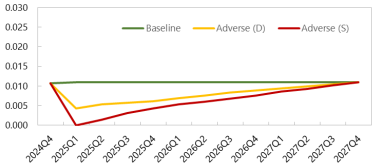
Notes: The FCI ratios here relevant are defined as 4-quarter trailing sums of FCI from sources other than AUM and credit business over 4-quarter trailing averages of total assets, at bank level. The charts here shown represent medians across the underlying banks. The vertical axes were set to have a common range as a visual support for cross-bank-cluster comparison.

Appendix VIII. Figure 9. Switzerland: FCI from Credit Business—Projections

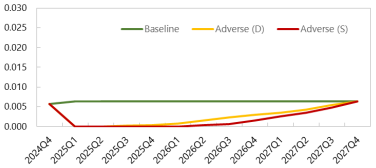
SIBs
(percent)



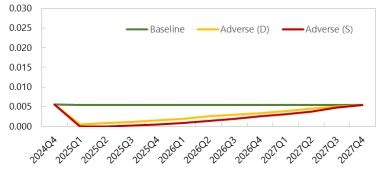
Cantonal Banks
(percent)



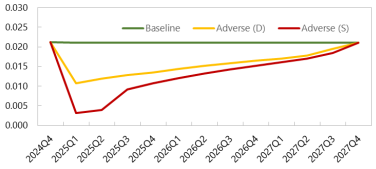
Asset and Wealth Managers
(percent)



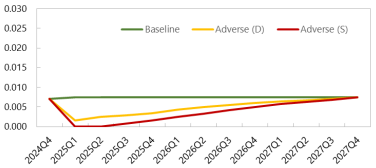
Regional Banks
(percent)



Other Banks
(percent)



All Banks
(percent)



Sources: IMF staff models.

Notes: The FCI ratios here relevant are defined as 4-quarter trailing sums of FCI from credit business over 4-quarter trailing averages of total assets, at bank level. The charts here shown represent medians across the underlying banks. The vertical axes were set to have a common range as a visual support for cross-bank-cluster comparison

Appendix IX. Climate Risk Analysis

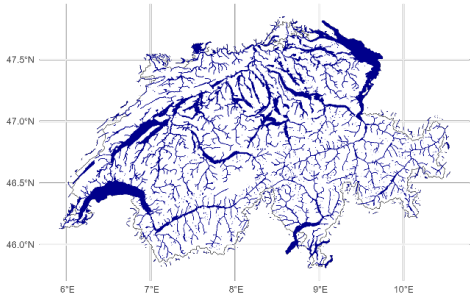
1. The hazard indicators consider the residential buildings to weigh the data and have an indicator that is representative of the exposure of interest rather, i.e., than mortgages. Each residential building hectare receives the hazard parameters, and then the indicator is the weighted average of these parameters using the number of buildings (Figure I1); a similar process applies to WRI, while the estimates from Munz et al. (2023) are already in terms of buildings, so did not require any treatment.

Appendix IX. Figure 1. Switzerland: Built of Flood Zone Hazard Indicator

The flood zones indicate the affected areas for different return periods…

Flood zone

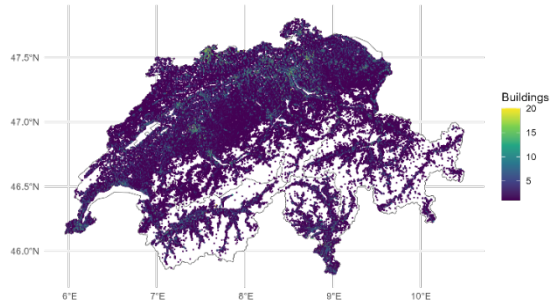
(1-in-500-year)



…the residential buildings are identified as being in or not the flood zones

Residential buildings

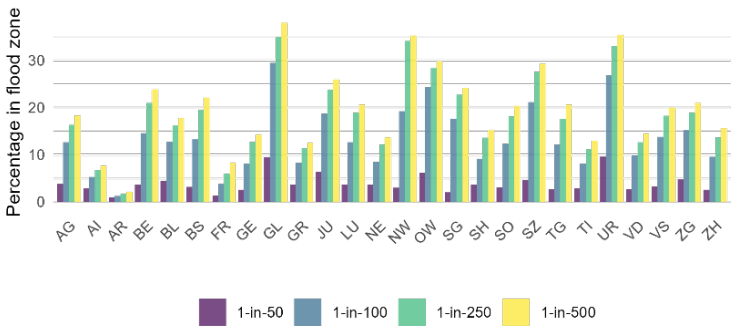
(number of buildings, 100 x 100 m)



…to build the percentage of buildings in the different flood zones

Residential buildings in flood zones by canton

(in percent)



Sources: FOEN, FSO, swisstopo, IMF staff calculations

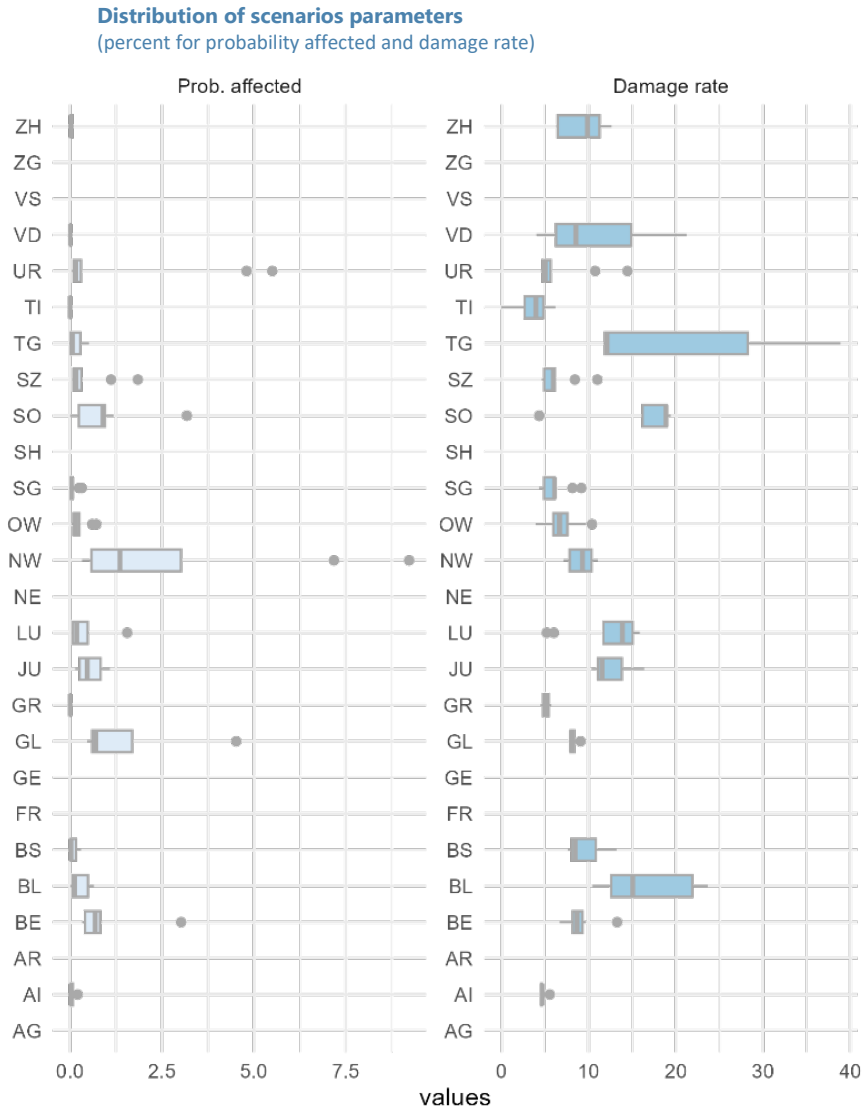
2. The flood dynamics scenarios from Munz et al. (2023) consider physically plausible scenarios for developing storylines for extreme riverine flood events and quantify the socioeconomic impacts. The nine flood event scenarios were expressed in terms of the probability of being affected and the damage rate at the cantonal and regional levels, the first to assess the bank's cantonal exposure and the latter to calibrate the impact of the damage on real estate.

Appendix IX. Table 1. Switzerland: Flood Scenarios

Scenarios	Return period	Impacted cantons	Impacted major regions
Worst case scenario	1-in-1000-year	ZH, BE, LU, UR, SZ, OW, NW, GL, SO, BL, AI, SG, TG, VD, JU	**CS, EM, ES, NS, RL, T, Z**
Reference scenario	1-in-100-year	ZH, BE, LU, UR, SZ, OW, NW, SO, BL, AI, SG, TG, JU	CS, EM, ES, T, Z
Precipitation+	1-in-300-year	ZH, BE, LU, UR, SZ, OW, NW, GL, SO, BL, AI, SG, TG, JU	CS, EM, ES, NS, Z
Wet preconditions	1-in-100-year	ZH, BE, LU, UR, SZ, OW, NW, SO, BL, AI, SG, TG, JU	CS, EM, ES, NS, RL, Z
Precipitation+, 5 days	1-in-100-year	ZH, BE, LU, UR, SZ, OW, NW, SO, BS, BL, AI, SG, TG, JU	CS, EM, ES, NS, Z
Reference scenario, West	1-in-100-year	BE, LU, UR, SZ, OW, NW, SO, BS, BL, SG, JU	CS, EM, ES, NS, RL, T, Z
West +	1-in-300-year	BE, LU, UR, SZ, OW, NW, SO, BS, BL, SG, VD, JU	CS, EM, ES, NS, Z
Focus on lakes, 3 days	1-in-100-year	ZH, BE, LU, UR, SZ, OW, NW, GL, AI, SG, GR, TG	CS, EM, ES, NS, Z
Focus on lakes, 5 days	1-in-100-year	ZH, BE, LU, UR, SZ, OW, NW, GL, AI, SG, TG	CS, EM, ES, T, Z

Munz et al. (2023)

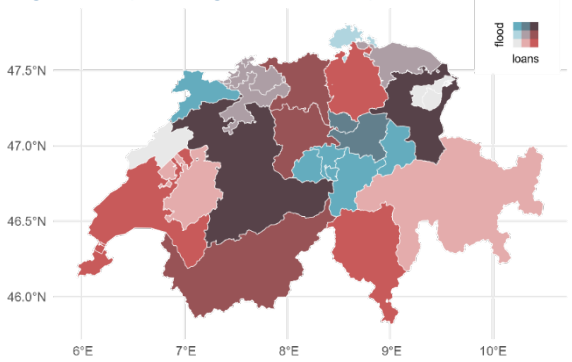
Appendix IX. Figure 2. Switzerland: Flood Scenarios by Canton Distribution



Sources: Munz et al. (2023), IMF staff calculations

Appendix IX. Figure 3. Switzerland: Banking System Exposure Actual Conditions

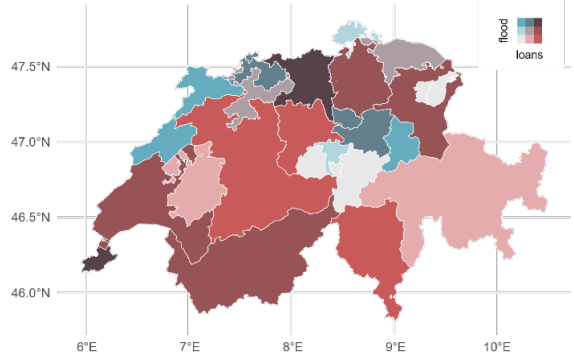
Mortgages Exposure to Floods Actual Conditions
(flood: in average annual percentage at risk; loans: percent of total loans 2015-2024)



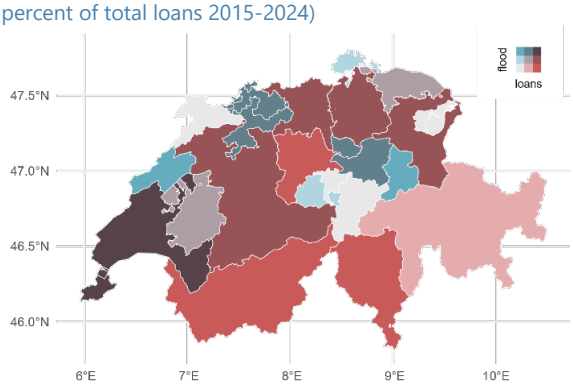
Sources: SNB, FINMA, FOEN, swisstopo, IMF staff calculations

Appendix IX. Figure 4. Switzerland: Banking System Exposure Future Conditions

Mortgages Exposure to Floods RCP4.5
(flood: relative change average annual flood depth; loans: percent of total loans 2015-2024)



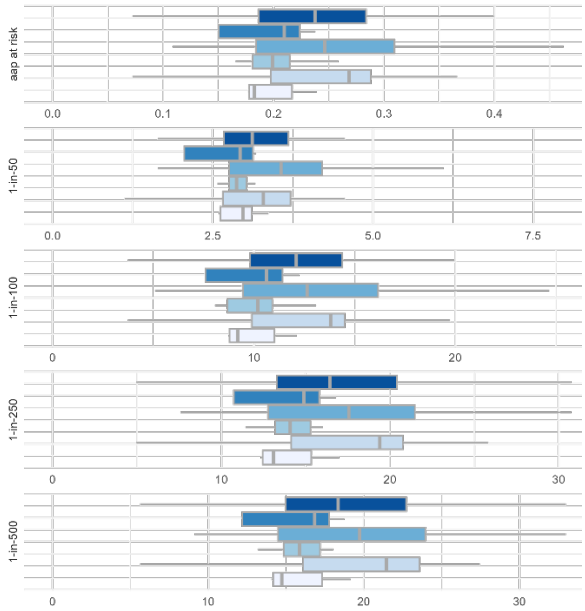
Mortgages Exposure to Floods RCP 8.5
(flood: relative change average annual flood depth; loans: percent of total loans 2015-2024)



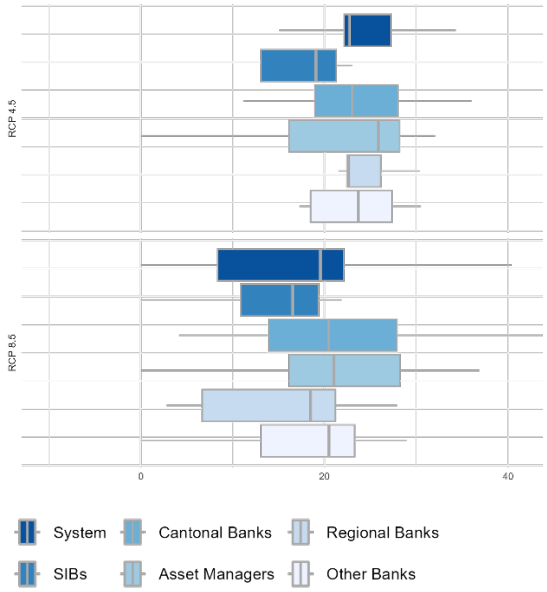
Sources: SNB, FINMA, WRI, swisstopo, IMF staff calculations

Appendix IX. Figure 5. Switzerland: Bank Exposure—Actual and Future Conditions

Banks Floods Actual Conditions
(meters weighted average with banks mortgages)



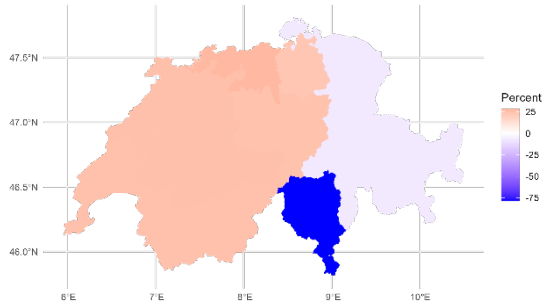
Banks Relative Change Floods Future Conditions
(relative change weighted average with banks mortgages)



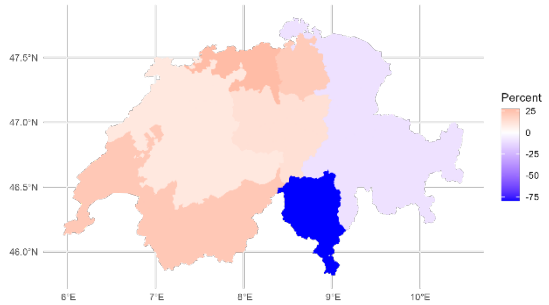
Sources: SNB, FINMA, FOEN, WRI, IMF staff calculations

Appendix IX. Figure 6. Switzerland: Floods Average Annual Damage—Future Conditions

Average Annual Damage Relative Change RCP 4.5
(percent)



Average Annual Damage Relative Change RCP 8.5
(percent)



Sources: WRI, Huizinga et al. (2017), swisstopo, IMF staff calculations